UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF NORTH CAROLINA
ASHEVILLE DIVISION

STATE OF NORTH CAROLINA, ex rel. Roy Cooper, Attorney General,	)	
Plaintiff,	)	No. 1:06-CV-20
vs.	)	VOLUME 9C
	)	PAGES 2203-2329
TENNESSEE VALLEY AUTHORITY,	)	
Defendant.	)	

TRANSCRIPT OF TRIAL PROCEEDINGS
BEFORE THE HONORABLE LACY H. THORNBURG
UNITED STATES DISTRICT COURT JUDGE
JULY 24th, 2008

APPEARANCES:

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I N D E X

DEFENDANT'S WITNESS:

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E X H I B I T S

DEFENDANT'S EXHIBITS:

NO.	DESCRIPTION	MARKED	RECEIVED
286	NC anthropogenic emissions	2206	2207
287	Contributions PM 2.5	2207	2209
288	CAMx PSAT-Alabama	2209	2211
289	CAMx PSAT-Kentucky	2211	2212
290	CAMx PSAT-Tennessee	2212	2214
291	CAMx PSAT-North Carolina	2214	2216
292	CAMx-TVA	2216	2222
293	NC-EGU	2222	2224
294	CAMx-Alabama	2224	2228
295	CAMx-Kentucky	2227	2228
296	CAMX-Tennessee	2228	2230
297	NC-EGU	2230	2232
299	TVA Sulfate deposition	2234	2237
300	NC Sulfate deposition	2237	2238
301	NC Sulfate deposition-Class 1	2238	2239
302	TVA Nitrate deposition	2239	2242
303	NC EDU-Nitrate deposition	2242	2244
304	NC anthropogenic sources	2244	2246
305	Nitrate deposition in NC	2246	2248
314	PM 2.5 in 2013	2248	2250
315	TVA's PM 2.5 in	2250	2254
316	NC PM 2.5 in 2013	2254	2255
317	NC 2013 plan/TVA 2013 plan	2255	2260
318	TVA Alabama 2013	2260	2265
319	TVA Kentucky 2013	2265	2266
320	TVA Tennessee 2013	2266	2267
321	CMAQ 2013	2267	2270
322	CMAQ 2013	2270	2273
323	CMAQ 2013	2274	2275
324	Source contributions, 8-hour ozone	2275	2278
325	Source contributions, 8-hour ozone	2277	2278

E X H I B I T S

DEFENDANT'S EXHIBITS:

NO.	DESCRIPTION	MARKED	RECEIVED
326	Source contributions, 8-hour ozone	2275	2278
327	TVA contributions, Sulfate 2013	2278	2280
328	NC contributions, Sulfate 2013	2278	2280
329	Projected 2013 Class 1-Sulfate	2280	2281
330	Future year scenarios	2281	2282
331	Projected 2013 Class 1-Sulfate	2283	2283
332	Nitrate deposition	2283	2285
333	Nitrate deposition	2283	2285
334	Nitrate deposition	2283	2285
335	Projected Nitrate	2013	2286
336	CSA-2013	2286	2287
337	Projected Nitrate 2013	2287	2288
338	Comparison impacts	2288	2290
339	CMAQ-2013	2290	

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P R O C E E D I N G S

THE COURT: All right.

MR. FEIN: Thank you, Your Honor.

CONTINUED DIRECT EXAMINATION OF THOMAS W. TESCHE BY MR. FINE:

Q. Dr. Tesche, at the lunch break we were about to look at the document that's been marked for identification as Defendant's Exhibit 286.

Thank you Ms. Shay.

Do you have that in front of you?

A. Yes, I do.

Q. And I believe this is once again in the series of information we've been presenting concerning PM 2.5 impacts in 2002 from zero-out modeling?

A. That's correct.

Q. What aspect of that is this figure demonstrating?

A. This figure depicts the modeled fine particulate PM 2.5 impacts, average annual impacts in 2002, that would result from zeroing out all of the North Carolina power plants.

Q. All the power plants or all the anthropogenic sources, Dr. Tesche?

A. I'm sorry. It is the anthropogenic sources. Excuse me. It's the zeroing out of all the anthropogenic sources in North Carolina.

And what we see as the spatial extent of the fine

particulate change as a result of zeroing out all the anthropogenic sources is a plume fingerprint that is larger than that associated with controls, or just zeroing out on the North Carolina power plant fleet.

MR. FINE: I would ask that Defendant's Exhibit 286 be admitted into evidence.

MR. GOODSTEIN: We have an objection, Your Honor, as to relevance, zeroing out all the anthropogenic sources in North Carolina in 2002. I don't see any relevance of it.

THE COURT: All right. That's your objection and it is overruled.

MR. GOODSTEIN: Thank you, Your Honor.

(Defendant's Exhibit Number 286 having been marked, was received in evidence.)

Q. (Mr. Fine) Dr. Tesche, if we could move to the document that's been marked for identification as Defendant's Exhibit 287.

Ms. Shay, if you could put that on the display.

Do you have that in front of you, sir?

A. Yes, I do.

Q. And I refer to this as a bar chart. This is more scientifically referred to as a histogram?

A. Both terms are correct.

Q. Well, let me stick with bar chart, that's a little easier on my tongue.

A. Okay.
Q. Now this is again focusing on 2002 annual PM 2.5?
A. Yes.
Q. Again, I'm assuming this is a zero-out scenario?
A. That's correct.
Q. And other than that, what are we looking at here?
A. What we're looking at is the relative contribution in the year 2002 of essentially four categories of sources that we zeroed out in this set of experts.

One was the TVA power plants. That's shown in their associated PM 2.5 shown in green.

The second is the North Carolina power plants, a separate model run with CMAQ, that's shown in yellow.

Thirdly is the anthropogenic sources in the State of North Carolina, that is shown in light blue.

And finally, all other sources outside of North Carolina shown in dark blue.

What this plot does -- what it shows is the three different SIP .5 nonattainment areas in North Carolina -- is depict the relative contributions of different source categories of -- beginning with power plants and going to essentially all manmade activities within the state, or within the upwind states, to allow us to understand the contributors to the fine particulate concentrations that the models estimate.

Q. This is for the -- I think you already said, sir, this is for the nonattainment counties in North Carolina?
A. Yes. These results are quad adjusted in this example, just for the three nonattainment categories.
Q. If you could indicate for us, what's the magnitude of the TVA contribution?
A. It's quite a bit less than 1 microgram per cubic meter. I would guess, just looking at the plot, that it's probably on the order of, oh gosh, .2 to .3, .4, somewhere in that range.

The exact concentration, if that is of interest, at each of these monitors is tabulated in our expert reports.

MR. FINE: Your Honor, I would ask Defendant's Exhibit 287 be admitted into evidence.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 287 having been marked, was received in evidence.)

Q. (Mr. Fine) Ms. Shay, if you would please display Defendant's Exhibit 288.

Dr. Tesche, if you could turn to that exhibit.
A. Yes, sir.
Q. Dr. Tesche, we seem to be moving into a somewhat different presentation with, marked for identification 288. Could you tell us what sort of presentation we're now looking at?

A. Well, these are not zero-out runs where we are looking at a hypothetical or extreme situation. Rather, we're looking at the output of the CAMx model with its particulate source apportionment technology applied. Still 2002 base year simulation here.

But the color that you see on the page is the estimate provided by the CAMx PSAT model of the annual PM 2.5 contribution throughout the southeastern United States that would be attributable simply to power plants owned by TVA in the State of Alabama.

And you see that the concentration ranges in the color go from .1 up to .3, or maybe even .4.

The raw data files, the archive data that we have, when we looked at the impacts in North Carolina from the Alabama power plants, were on the order of .05 -- excuse me -- .1, .1 microgram per cubic meter.

Q. Just so that we can pursue this a moment or two longer Dr. Tesche, looking at marked for identification Defendant's Exhibit 288, it's as if they are looking at two eyes located in the northern part of Alabama. Do you see those, sir?

A. Yes.

Q. Would I be correct in surmising that those are at or near the actual locations of the TVA Colbert plant in northwestern Alabama and the TVA Widows Creek plant in northeastern Alabama?

A. That's correct. This model output shows pretty clearly the finding that SAMI and VISTA and many studies have shown that the PM 2.5 maximums tend to occur fairly close to the large sources of the type of air pollution.

Q. I believe that was a lesson from SAMI?

A. That was certainly articulated by SAMI as one of their final conclusions, one of the main conclusions.

Q. Is that something concerned by VISTAS?

A. Yes. In fact, that finding was one of the outcomes of the OTAG, Ozone Transport Assessment Group Study. One of their key findings was that the effects -- the biggest effects of sources occurs locally or within the same state of that source location.

MR. FINE: I would ask that Defendant's Exhibit 288 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 288 having been marked, was received in evidence.)

MR. FINE: If you would display Defendant's Exhibit marked for identification 289, Ms. Shay.

Dr. Tesche, do you have that before you?

A. Yes.

Q. Dr. Tesche, in the interest of trying to move along with all this information, my understanding is that this is again a PSAT from the CAMx model?

A. That's correct.
Q. For 2002 particulate matter?
A. That's correct. It's a CAMx PSAT output, estimating the PM 2.5 impact associated with TVA power plants in the State of Kentucky.

And the color you see is a general range of 2 to -- or excuse me -- .1 to .3 or .4 micrograms per cubic meter. The maximum impact from the Kentucky TVA power plants is .05 micrograms per cubic meter in the State of North Carolina.

MR. FINE: I would ask that Defendant's 289 be admitted.

THE COURT: It is admitted.

(Defendant's Exhibit Number 289 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defendant's Exhibit marked 290.

Do you have that in front of you, Dr. Tesche?
A. Yes, sir.
Q. This is a lay person's reaction to this, Dr. Tesche. This appears to be a rather more dramatic looking tile plot than the other last two we've looked at?
A. Well, there's certainly more color on the pages, as you would expect. Because what we're modeling here, what we're showing here is the CAMx PSAT results, PM 2.5 estimates from

CAMx, associated with emissions in 2002 from the TVA sources -- or TVA fossil plants in Tennessee. And there's more emissions from those sources in Tennessee than the preceding two states.

So you would expect to see, and indeed we do, higher PM 2.5 signatures. Not only in the State of Tennessee, but also going over the border into North Carolina.

Looking over at the color plat, we see sort of a light blue or light green, I suppose, and have a concentration range of .3 to say .5 or so.

When we analyze the actual data that built this plot, data in North Carolina, we found that the peak concentration here was .48 micrograms per cubic meter in the State of North Carolina.

Q. What geographic area in the State of North Carolina registered that peak impact of 0.48 micrograms per cubic meter?

A. Well, it was right along the border. Just very close proximity to the border between the two states.

Q. Just so that we're clear in terms of a reference point, Dr. Tesche, what's the -- would you remind me again of what the levels are that could be detected by field monitor?

A. The current sensitivity thresholds for fine particulate monitors that are operated in the field, operated by the improved network from EPA, is about .5 micrograms per cubic

meter for the annual average. That's about as low as they can go in routine operation.

The significance level that EPA attaches to PM 2.5 estimates from models, as expressed in the CAIR work, is .2 micrograms per cubic meter.

MR. FINE: I would ask Defendant's Exhibit 290 be admitted into the record.

THE COURT: That will be admitted.

(Defendant's Exhibit Number 290 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display what is marked for Identification 291, Defendant's Exhibit.

Dr. Tesche, do you have that in front of you?

A. Yes, I do.

Q. Sir, this is another one of what I'm going to call a bar chart; is that right?

A. Yeah. Stacked bar chart, because we're stacking several contributions on top, and all in one bar.

Q. Stacked bar chart?

A. Stacked bar chart, correct.

Q. Sir, is this a stacked bar chart representing more information from the CAMx PSAT run?

A. Yes, sir, it is.

Q. What sort of information is it displaying?

A. What this displays is the relative contribution of PM

2.5 given by the CAMx PSAT model at the three nonattainment areas in North Carolina under the conditions in 2002.

What's being plotted in light blue is the TVA/Alabama EGU's. Green is the TVA/Kentucky EGU's. And the larger bar is the Tennessee EGU's for TVA.

Then in comparison for context, we also presented the North Carolina power plant emissions in the dark blue.

And what this allows us to see is the, not only the relative contribution of the different power plants in the four different states, but also how they vary, geographically, from west to east.

We see that the TVA contribution from Tennessee sources is larger as you're closer to the Tennessee border, as you would expect. And diminishes as you go farther eastward.

Overall, though, the Tennessee -- excuse me. The TVA, Alabama and Kentucky plants seem -- are predicted by the model to have very little influence on annual PM 2.5 concentrations in the year 2002.

Q. Dr. Tesche, a couple of points would help with my understanding of this stacked bar chart.

Once again, these are PM 2.5 nonattainment counties in North Carolina?

A. They are.

Q. If I could direct your attention to the scale on the left-hand side of marked for identification as Defendant's

291, what scale are you using with this stacked bar chart?
A. In this scale, we're presenting the modeled results in a scale, the ordinant or Y Axis from zero to 1.6 micrograms per cubic meter.

And that scale is essentially one tenth, or nearly one tenth of the annual federal standard of 15 micrograms. So what you're seeing here are that the impacts from essentially all the EGU's are small relative to the total PM 2.5 standard, and at the three different nonattainment monitors in North Carolina.

MR. FINE: I would ask Defendant's 291 be admitted into evidence.

THE COURT: Received.

(Defendant's Exhibit Number 291 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, if you would please display Defendant's Exhibit 292.

Dr. Tesche, do you have that in front of you?
A. I do.
Q. I believe, Dr. Tesche, we are changing pollutants, correct?
A. We're changing pollutants, that's correct, and models, as well.
Q. And models as well. Thank you. This is now -- we're now looking at the information concerning ozone?

A. That's correct. We're looking at a zero out run for ozone that we carried out with CMAQ model for year 2002. Again we're looking at the maximum 8-hour ozone. And this plot depicts the maximum change in 8-hour ozone over the summer, May through September ozone season, that would result from a hypothetical case in which we set to zero all the TVA power plant emissions in three states.

Q. Once again, we're talking about shutting down the entire TVA fossil fleet in all of three states?

A. That's correct.

Q. Dr. Tesche, before we get into the information that this figure is showing us, if I could direct your attention to the scale that's displayed on the left-hand side of marked for identification Defendant's 292?

A. Yes. This scale is in parts per billion. The color scales are based on uniform -- I think they're uniform -- I think that 9 might be a misprint. I think that's an 8. Should be an 8 on the scale.

Anyway, uniform increments of ozone by color. And we're measuring or depicting ozone in a range that's essentially one half of the federal standard of 75 parts per billion.

And the color on the page you see is the predicted ozone change that would result if you were to set to zero all TVA power plants in the year 2002.

Interpreting the color on the plot in the region of the Tennessee/North Carolina border, we see that they're a sort of blue-ish tinge, which would correspond to ozone changes on the order of 4 to 12 to 14 to micrograms -- excuse me, parts per billion.

Q. Before we delve into that a little deeper, I notice on your scale, Dr. Tesche, that the increment from zero to four is displayed as white-to-gray on the figure; am I correct?

A. That's right.

Q. Dr. Tesche, could you please explain why you selected zero-to-four increment to be displayed essentially as a uniform or gray or white color?

A. As I mentioned earlier, when we produce these plots, we have to consider a few factors. But the overriding one for us is, we want to portray this information in a manner that best tells the story that is to be told, or that needs to be told with this information.

In my opinion, by selecting a concentration range that shows the color between, say, a low number of four, which is small, relative to the measurement capabilities of ozone monitors. And a large scale that is not so high that it obscures the peaks on the page. We have created a plot that gives a sense of the geographical extent of meaningful concentration changes, together with some precision in the location of the peaks. And that's why the scale range of

zero to 36 PPB is a range that we have chosen.

Now, I would add that we're not just producing this page when we generate our output. We generate thousands of pages like this for different pollutants and different days. We do this on a day-by-day basis as well.

At first pass, we try to automate the selection scales as best we can, at least by pollutant. So there's several considerations that go into this type of plotting.

But my opinion is that this is a reasonable scale to depict the main message.

Having said that though, in areas of particular interest, as in this case, we've also gone back at the underlying data and examined, on a grid-so by grid-so basis if need be, what are the peak areas of concentration where this is occurring.

Here this would be along the border of North Carolina, where we see a graduation from blue color to white color.

We're not necessarily going to run off to the extreme eastern portion of North Carolina and examine those numbers, necessarily, because our experience tells us that the concentration results drop off fairly sharply. And so we're not likely to find meaningful results out to the white, particularly when the white is a low concentration range that is within the range that EPA declares or -- or EPA doesn't use when they are cross-calibrating their monitors.

Q. Let's pursue that point for just a moment more, Dr. Tesche.

What's the monitoring sensitivity for ozone, if you know, sir?

A. It depends on the instrument that you're using. One of the most popular instruments over the last many years has been a chemiluminescence technique. And EPA uses that technique widely.

In EPA's guidance documents, or at least the documents where they interpret ozone air quality data, they do not process data below five parts per billion for ozone, as a rule, especially when they're comparing different instruments, calibrating or challenging different ozone measurements. They don't have the confidence in concentrations below 5 PPB at least.

So that provides some insight, at least, into a lower range of data. I'm sure that research grade instruments -- and I have to say that I'm not an expert in instrumentation, necessarily, but I've used the data from instruments all my career. I would bet that there are laboratory instruments that can get down below five -- or excuse me -- five parts per billion.

EPA picked two PPB as the significant range for the CAIR modeling.

In carefully controlled laboratory settings, I would

expect that you could get lower ozone determinations than certainly the 5 PPB outside in the field.

Q. Dr. Tesche, let's return to what the modeling behind this chart in this figure itself shows, in terms of the ozone impacts in North Carolina.

And again, this is a zero-out scenario?

A. Yes, sir.

Q. And with shutting down the entire TVA fossil fleet, what's the range of impacts in North Carolina that would result in such a hypothetical happenstance?

A. Well, just looking at the color here, it looks like the range is on the order of 9 to 14. There's some green there, so possibly as high as 16, 17, 18, 19.

The number 17 stands, in my mind, as a peak concentration in this area. But I'm uncertain about that number as the exact. But it corresponds to the color range here.

I should point out that 17 is certainly a larger ozone number than we've been talking about to this point.

We have looked at the specific days during the 2002-meteorology to find out what the underlying concentrations have been in this region.

Our findings have been on days where CAMx and the CMAQ models are producing their highest incremental impact from the western power plants that they don't correspond with

days where this portion of North Carolina has its highest ozone.

So while the number may be large, it's not occurring on a day where the ozone was approaching the standard.

Furthermore, this is an extreme case. This is a reduction of all TVA emissions, and not something likely to occur.

MR. FINE: I would ask Defendant's Exhibit 292 be admitted into the record.

MR. GOODSTEIN: Your Honor, on behalf of North Carolina, it's the same objection. It's misleading because they don't show any results below 4 parts per billion. They also don't show the maximum results on this, which are 43 parts per billion. It only goes up to 37.

THE COURT: Overruled.

MR. GOODSTEIN: Thank you, Your Honor.

(Defendant's Exhibit Number 292 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defendant's Exhibit 293.

Do you have that in front of you, Dr. Tesche?

A. Yes, sir.

Q. Sir, I think in terms of concept, this is somewhat similar to one of the tile plots we looked at before. This would be the zero out for North Carolina power plants for

ozone as opposed to particulate matter?

A. That's correct. We would use the same scale for ozone concentrations from zero to 36.

What we see in this plot is, that by zeroing out the North Carolina power plant fleet, that we get impacts in the region as high as 24 parts per billion.

You can also see that by the information on the legend, "Max equal 24," is a shorthand for the maximum ozone change on the grid. And the coordinates after are the X and Y coordinates for that peak impact.

The coloring depicts the geographical extent of the modeled impacts from the zero-out run. And we see that in North Carolina the concentration runs from, say, from 9 or 10 parts per billion up to the green range, which is on the order of, say, 15 to 22 or something thereabouts.

Q. What does this plot show for North Carolina's impacts in other states?

A. Well, this plot reveals that the CMAQ model run for North Carolina sources predicts that there will be concentration impacts that could be as much as 14 to 18 parts per billion, based on the color scheme here, in the State of Virginia, and lesser impacts in the State of South Carolina. A little bit in western -- or excuse me -- eastern Tennessee, and in West Virginia.

MR. FINE: I would ask that Defendant's Exhibit

293 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 293 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defense Exhibit 294 marked for Identification.

A. Yes, sir. I have this.

Q. Dr. Tesche, is this -- is this a tile plot built around the -- I think it was the OSAT tool with CMAQ?

A. That's correct.

Q. And this is displaying information concerning what ozone impacts from TVA's Alabama plants?

A. That's right. We have a different method of presentation here.

As you might expect with a discipline as intricate as ozone chemistry, or PM chemistry in the atmosphere, especially using grid models that predict information in a variety of different grid cells, there are a number of different ways that the analyst can examine the data and present it.

And this is an alternative examination of the ozone data from CMAQ that's aimed at trying to give the reader or the reviewer some insight into the impact on days where it might matter, on days where the ozone concentration have been high.

Previously we've been showing residual plots. The impact of PSAT runs, or zero-out runs declared on the days when these impacts occurred that the ozone levels or the PM levels were small, based on inspection of the data.

Here what we're doing is looking at the impact on days that have been stratified to contain only those high ozone days.

So this plot only addresses days when the 8-hour ozone in the domain was higher than the previous ozone standard of 84 parts per billion.

The average fraction, essentially, is the average ozone concentration associated with the CMAQ, OSAT -- the CMAQ OSAT ozone prediction.

It's the average amount of ozone results for the Alabama sources, divided by the total ozone concentration in that grid cell.

So the plot is done grid cell by grid cell. And in each grid cell we form a number. The denominator is the average ozone for all of the days that we model in that cell above 84 PPB, and the numerator is the average OSAT prediction for all of those days above 84 PPB, for emissions just from Alabama power plants.

Q. From TVA Alabama power plants?

A. That's correct. Excuse me. It's a metric that's a little more challenging to understand or grasp. It does

have the power of allowing you to see the impacts of a source category, here the TVA Alabama plants, for those days that possibly mattered, because the ozone concentration, the background concentration is high.

What we see here is the average fraction of days when the ozone associated with the Alabama TVA power plants is on the order of, say, .1 to .2 or .26 as a numerical value. So the -- that's the numerical value.

There isn't a standard for this. So the quantity really only has context when you compare it with other source categories or other states, which we did for Kentucky and Tennessee.

Q. Dr. Tesche, appreciate that explanation.

Could you tell us what does the figure show us in terms of the ozone impact from TVA's Alabama plants. Where does that seem to occur on what you say -- on the days that might matter?

A. Well, the ozone impact up here occurs generally in the near or intermediate range downwind of the sources of the Alabama power plants. You can see the two Alabama source locations there because of the green coloring.

But those ozone plumes do extend downwind, as you would expect, in the atmosphere. There is -- does appear to be a little bit of color in the extreme southwestern portion of North Carolina. I don't recall off hand what that fraction

was. The color to me looks like a dark blue, so that would be from .03 to .06.

Again, there's no standard for this, so the most straightforward way of interpreting this is to compare this with other examples to get a sense of, you know, whether this seems important to us or not.

MR. FINE: I would ask that Defendant's 294 be admitted.

Ms. Shay, if you would please display Defendant's Exhibit 295.

Dr. Tesche, is this a similar display for the ozone impacts from TVA's Kentucky plants?

A. Yes, it is. Same sort of display. The only difference is that it's the CMAQ OSAT results plotted with this average fraction metric associated with the Kentucky TVA power plants. See, the peak impact is a little less than the Alabama example.

Q. And where do those impacts take place?

A. Mostly in western Kentucky, southern Illinois, southeastern Missouri, essentially along the lower reaches of the Ohio River as it passes out of Kentucky.

There does not appear to be in this plot any impact in North Carolina. Although, I won't declare that the impact is zero. I, frankly, don't recall from this picture if there was a nonzero value in North Carolina at this time.

Were there such a value, I believe it would have been documented in our expert report.

MR. FINE: Ask that Defendant's 295 be admitted.

I'm sorry, Your Honor?

THE COURT: Let 295 be admitted.

MR. FINE: Your Honor, I asked for 294 as well. I'm not sure I heard a ruling from the Court.

THE COURT: I didn't know you had. Okay, 294, 295. All right. That's admitted.

(Defendant's Exhibit Number 294, 295 having been marked, were received in evidence.)

MR. FINE: Thank you, Your Honor.

THE COURT: Yes.

MR. FINE: Ms. Shay, please display marked for identification 296.

Dr. Tesche, do you have that?

A. I do.

Q. And again, following the same sequence as we did with the PSAT results for the TVA plants in the various states, I'm assuming this is the OSAT results, the ozone impacts from TVA Tennessee fossil plants?

A. It is. This is another example of the average fraction, ozone impacts. But this time it is the emissions from the TVA power plants in Tennessee that we're examining with the OSAT technology and CMAQ. And we see that the

maximum fraction, that is the maximum fraction associated with the average TVA impacts, divided by the mean value of the concentrations in the grid cells, is about .26. And it occurs in central or west central Tennessee.

There is some impact in North Carolina, as you can see from the isoplot. Fractional impacts look like they extend from .06 up to maybe as high as .12.

Q. If you'll help us here, Dr. Tesche, that kind of fractional impact, what does that means in terms of the impacts of the Tennessee TVA impacts on ozone in North Carolina?

A. Well, the fractional impact, according to this plot, in North Carolina, just by eyeballing the color, looks like it's on the order of, let's say, a .1 to .12, something in that range. That's about a tenth, let's say.

And what that means is that the ozone contribution from TVA power plants in this set of grid cells along the border might be a tenth of the average value of the underlying ozone that occurs on those days that were greater than 85 parts per billion in this area.

It's not a metric, as common and household metric as say, a residual or difference plot, as we've been looking at.

It's a helpful presentation in terms of examining the changes from one geographical area to another of source

categories.

MR. FINE: Your Honor, I would ask Defendant's 296 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 296 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defendant's 297.

Dr. Tesche, this appears to be another in the series of OSAT presentations for ozone?

A. Yes, it is. Yes.

Q. What is this figure showing?

A. This figure shows the similar results for the average fraction, but based on the North Carolina EGU's.

One thing that I haven't mentioned in connection with these plots is that, since we're dividing by -- or since the plot number -- the metric is normalized by the high concentration days, if there are impacts in regions where there are a lot of days where ozone concentrations are high, it's likely that this metric will show higher values than if you had just a few days where concentrations are high.

And what we see in this particular plot is that the -- there's very little impact in Tennessee as a result of the North Carolina power plant fleet for 2002.

The primary impacts from this metric with North

Carolina power plants seem to occur on the borders of North Carolina, with its neighbors, Virginia and South Carolina. At least that's where the regions of colored -- green-colored impacts are predicted by the CMAQ model.

Q. What sort of -- what's the magnitude of those impacts, if you could tell us, sir?

A. Well, they're green, so -- and the maximum impact on the legend down below is .15. So they're in the range of .1, .12, to .15.

Q. How does that compare to the impacts from the TVA's Tennessee plants on ozone in North Carolina reflected in Defendant's 296?

MR. GOODSTEIN: Your Honor, for clarification on the question, we're talking about 2002?

MR. FINE: Yes.

THE WITNESS: Yes.

Q. (Mr. Fine) And what is that comparison, Dr. Tesche?

A. Can you clarify the question in terms of where geographically you're interested in the impacts?

Q. What I'm trying to clarify are the impacts demonstrated in Defendant's 296 of the Tennessee Valley Authority plants in Tennessee/North Carolina with 297, the impacts of North Carolina power plants in North Carolina.

MR. GOODSTEIN: Your Honor, same request for clarification. This is 2002 data, before any emissions

reductions associated with the Clean Smokestacks Act were implemented in North Carolina. So we're comparing historic emissions in North Carolina that don't exist any more, to data from Tennessee in 2002. We have a relevance objection.

THE COURT: I'll let you go into that.

Q. (Mr. Fine) Dr. Tesche, can you respond to the question?

A. In the State of North Carolina, the previous Defendant's Exhibit 296 shows pretty clearly that the extent of TVA power plants' impact on North Carolina using this metric is quite limited geographically. The impacts are on the order, as I said before, of .06 to, say, .12 at the most.

Whereas in North Carolina, the impacts from the North Carolina power plants are producing an impact that is on the order of .06 up to a maximum of .15.

So they're slightly higher in North Carolina as the result of the North Carolina power plants. They're closer to the source for each of them.

MR. FINE: I would ask Defendant's 297 be admitted into the record.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 297 having been marked, was received in evidence.)

Q. (Mr. Fine) Dr. Tesche, I want to spend just a moment or two on the question of visibility. And again, I think as

we've indicated previously, TVA will be presenting testimony from another individual concerning visibility matters.

But, Dr. Tesche, I believe that your expert disclosure reports reflect a good deal of information concerning visibility matters?

A. They did.

Q. And sir, did you provide information to Dr. Ivar Tombach on the visibility questions for both 2002 and 2013?

A. We did.

Q. Could you just summarize for the record the information that you and your modeling team provided to Dr. Tombach?

A. The models that we used produce a tremendous amount of output. What we wanted to do was provide Dr. Tombach with the appropriate information that would flow smoothly into his analysis procedures. The CMAQ model will predict estimates of visibility impacts.

The information we gave Dr. Tombach came directly out of the CMAQ model, though we reformatted it to make it easier for him to use.

But it was estimates of the haze index at a variety of locations, together with information on the relative composition of the chemical species that make up PM 2.5, that are used in the CMAQ model, following an output, and developed by EPA and others, to produce the deciviews or haze index according to agreed upon algorithms.

So we provided him with the, essentially the full amount of the visibilty information needed to perform his analysis at the Class 1 areas.

We had more information we could have unloaded on him. We simply gave him the pertinent information that he needed.

Q. That was both 2002 and 2013?

A. Yes, sir.

Q. Appreciate that, sir.

Ms. Shay, if you would please display, marked for identification Defendant's Exhibit 299.

Dr. Tesche, I believe we're switching to a different -- I'm not sure exactly how to describe it, but a different sort of deposition.

A. It's a residual plot that shows the difference between -- in the year 2002, the baseline simulation, and the effects of zeroing out all TVA power plants, fossil plants, in the year 2002.

And what it depicts is the ground level distribution of sulfate deposition in the year 2002. It's a map of where the acid deposition from sulfate would occur attributable to the TVA power plants.

Again, it uses this odd sort of metric kilograms per hectare. And we have plotted that from a mass loading, or a flux standpoint, from 2 kilograms per hectare up to a value of 20 or so.

Most of the impacts in the south central U.S. are in the range of, say, 2 to oh, maybe 16 kilograms per hectare.

There is a small amount of deposition in North Carolina attributable to the TVA power plants. And the impacts appear, by eyeball, to be in the range of 2 to 4 kilograms per hectare.

Q. If I'm looking at this plot correctly, those impacts occur somewhere close to the western border of North Carolina?

A. Yes, sir. They're in the mountainous region.

Q. If we spend a moment or two looking at the scale that you used with this figure, would you explain the considerations that lead to your selection of this particular scale for this display?

A. Again, the key theme here -- the key intent was to portray the results that told the main story of the model simulation in this case. We chose not to portray acid deposition in the range from zero to 2 kilograms per hectare because those concentrations are so low, or those deposition fluxes are so low.

We wanted to focus on where the main information content was in this plot. And I think we achieved that with this color scheme.

The peak impact is 25. So that number exceeds, by quite a bit, the darkest red scale.

But I think that the location of the peak is pretty well defined. And the geographical extent of the deposition is well-defined as well.

If we were to have selected a lower threshold, let's say a 1 kilogram per hectare or a half a kilogram per hectare, we would see a larger cloud than is depicted here in blue.

But, geometrically, it would have the tendency to mimic this blue cloud, but just a bit larger.

There is no standard, necessarily for kilogram per hectare impacts. Not like there is for ozone or PM 2.5. So we didn't have that threshold with which to contrast these results.

Q. And again, sir, this is under the hypothetical -- I think you determined the implausible hypothetical of shutting down the TVA fossil fleet?

A. That's true. And also it reflects 2002 emissions, which we know are overestimates of what conditions we know to be in 2013. There's substantial emission controls called for in both TVA and North Carolina fleets by 2013.

MR. FINE: I ask that Defendant's Exhibit 299 be admitted into evidence.

MR. GOODSTEIN: Same objection, Your Honor. It doesn't show the lower end values, and it doesn't show the higher end values, so it's misleading.

THE COURT: All right. Overruled. Let it be admitted.

MR. GOODSTEIN: Thank you Your Honor.

(Defendant's Exhibit Number 299 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defendant's Exhibit 300.

Do you have that before you, sir?

A. Yes.

Q. Very briefly. Is this once again a concept, a similar tile plot to Defendant's 299, except showing the zero -- zero-out impact for North Carolina power plants for sulfate deposition?

A. Yes, it is. One distinction I see here is that the peak sulfate deposition attributable to the North Carolina plants is a value of 17, which is somewhat less than -- make sure I'm correct in that.

Yeah. It's less than 25-kilogram per hectare peak from the TVA power plants that occurred within the State Of Tennessee, downwind of its sources. Somewhat lower impacts within the State of North Carolina, but there still are deposition impacts in surrounding states, including South Carolina, North Carolina, that are in the range of, say, 2 to 4 to perhaps 8, maybe close to 10 kilograms per hectare.

Q. And what about Virginia?

A. If I did not say Virginia, I meant to include Virginia, which is shown clearly, or at least it is evident, on this plot.

MR. FINE: I ask Defendant's Exhibit 300 be admitted.

MR. GOODSTEIN: Your Honor, same objection. The North Carolina Clean Smokestacks Act was implemented in 2002. This is 2002 data that doesn't show any of the emission reductions associated with the act.

THE COURT: All right. Overruled. Let it be admitted.

(Defendant's Exhibit Number 300 having been marked, was received in evidence.)

Q. (Mr. Fine) And finally in the sequence concerning sulfate deposition, Dr. Tesche, I would like to direct your attention, and ask at the same time Ms. Shay to display, marked for identification Defendant's Exhibit 301.

A. I have that in front of me.

Q. This is another set of stacked bar charts?

A. These are stacked bar charts with the year 2002. And they depict the relative contributions of three source categories, TVA power plants, North Carolina power plants, fossil plants, and other sources in the southeastern United States as they are predicted by CMAQ, in the year 2002, to contribute to sulfate deposition at a number of sampling

locations across the State of North Carolina and in Virginia -- Shenandoah, in Virginia.

These are sampling sites in the national acid deposition monitoring program network.

And the green -- variation in green shows the spatial variation in deposition associated with TVA power plants. That varies from west to east, as does the North Carolina power plants.

On the far west portion of North Carolina we see clearly that TVA has a somewhat greater contribution to wet deposition at Look Rock NADP monitoring station, National Acid Deposition Program, as opposed to the Shenandoah site in Virginia, which shows a greater contribution from North Carolina power plants than TVA.

Overwhelming the power plant contributions, though, are the deposition totals contributed by other sources.

MR. FINE: I would ask Defendant's Exhibit 301 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 301 having been marked, was received in evidence.)

MR. FINE: And would Ms. Shay please display Defendant's Exhibit 302.

Dr. Tesche, appear to be moving to a series of exhibits concerning nitrate deposition as opposed to sulfate

deposition?

A. Correct.

Q. I believe there has already been testimony to this effect, that nitrate is another component of acid deposition?

A. Yes, it is.

Q. This document that's been marked for identification as Defendant's Exhibit 302 is again a zero-out team showing TVA's deposition to nitrate deposition?

A. That's correct. This is a nitrate set of results for a run which we zeroed out TVA power plant emissions, nitrogen and SO2, and portrayed the result of nitrate impacts across the southeastern United States.

On this plot, we're presenting the nitrate deposition fluxes to the ground in a different range. Nitrate has a somewhat lower deposition rate, right to the atmosphere in general.

The deposition rate that we're plotting here goes from zero to 3 kilograms per hectare. Our threshold of plotting here is .03 kilograms per hectare, up to a maximum of three.

What we see from this plot is most of the nitrate deposition associated with the TVA power plants occurs within the State of Tennessee or northern Alabama or in Kentucky, by the power plants there.

There is some nitrate deposition across the border into

North Carolina. The impacts are in dark blue, and looks like there's one monitor that straddles the fence between the two states, and it's colored a light blue.

So those nitrate deposition impacts occur on the order of 06 to 1.2, or somewhere in that range, for the whole year of 2002.

Q. And again, Dr. Tesche, you seem to have the increment from point -- from zero to approximately 0.3 represented as either gray or white?

A. That's correct.

Q. And why did you choose to display that increment in gray or white uniform tones?

A. Sir, I've been developing these types of plots for probably 25 years. I have developed, as have my colleagues, an understanding in the variation of concentration fields of many of these atmospheric properties or compounds. Very often we will select a lower-end scale that drops off to shading.

And it's not just my representation or TVA's, but this is a common practice in the field. Taking a look at the EPA documents, the CAIR documents or other reporters, you'll see a cutoff threshold.

I picked this one here because, as I said earlier, it allows us to focus on the main story here, the nitrate deposition. It is a trivial exercise to plot these

deposition rates at higher or lower concentration rates.

In the instance of a high concentration range, we peak out at 3.0. The scale stops at 3.0, yet the legend clearly says that the peak value is 3.3.

Well, if you look at the coordinates of 10848 and try and figure out how to map those on the plot you see there, you will find that the peak of 3.3 sits in the middle of that dark red. So the peak is plotted. It's not portrayed in a way that, really, the peak stands up, you know, in clear distinction to its neighbors than a slightly lower deposition flux increment.

So it's a balance between trying to get the main message across, which I believe we've done here, and trying to present such fine detail and information that may or may not be relevant that you miss telling the main story for a lot of detail that's superfluous.

MR. FINE: I would ask Defendant's 302 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 302 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defendant's Exhibit 303.

Dr. Tesche, would you please turn to that?

A. Yes, sir.

Q. This is, in a way, a companion piece to the earlier figure we looked at for zeroing out North Carolina power plants for sulfate deposition; am I correct?

A. That's correct. In this case we are examining the nitrate deposition, again with a lower scale. It is the North Carolina power plants that have been hypothetically set to zero. And we are displaying here, the geographical extent and spatial magnitude of the predicted nitrate deposition fluxes.

There is some very modest nitrate creeping over the border into Tennessee. Predominance of the nitrate fingerprint is in the State of North Carolina, South Carolina and Virginia and western Virginia.

As the legend says, the peak deposition flux is 1.5 kilograms per hectare. Which is about halfway up our color legend here on the left-hand side.

Q. And where does that peak take place, sir, if you can tell?

A. In this plot, it's hard to say for sure. There are a couple of light green boxes. And, quite frankly, to try and figure out where the grid cell, X equal 117, white 52, your eyes are better than mine. If you had a protractor, you might be able to determine which of those two light green boxes the peak impact was in. We can certainly --

Q. Is it somewhere along the North Carolina --

A. It's somewhere along the border -- as you can see clearly in the plot, it's somewhere along the border shared by North Carolina and Virginia.

MR. FINE: Thank you, sir. I ask Defendant's Exhibit 303 be admitted.

MR. GOODSTEIN: Same objection, Your Honor, regarding data from 2002 North Carolina plants.

THE COURT: Overruled.

(Defendant's Exhibit Number 303 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defendant's Exhibit 304.

And Dr. Tesche, please take a look at Defendant's Exhibit 304.

A. Yes.

Q. Again, in sequence, this is zeroing out North Carolina's anthropogenic sources for nitrate deposition?

A. That's correct. As you can tell, we've done a systematic examination of the sulfate and nitrate deposition by the different source categories.

And this particular plot shows the geographical extent of the nitrate deposition flux, the flux in kilograms to the surface area in the historical year when the VISTAS database was developed and evaluated.

It shows that the anthropogenic sources in North

Carolina. There is a broad region over the central portion of the state that is receiving nitrate fluxes that, by the color coding, would appear to be in the 2 to 3-kilogram-per-hectare range. The peak on the legend shows it's as high as 4.4.

There do appear to be higher deposition fluxes on the border between Tennessee and North Carolina.

And in fact, nitrate deposition from the North Carolina anthropogenic source simulation that we made go all the way up to central Tennessee. And the fingerprint covers a fairly large portion of the northeastern U.S. seaboard.

Q. This fingerprint in terms of -- let me back up and ask you this. This also shows impacts in Virginia and South Carolina?

A. It shows impacts in those states, as well as other states, as far up as in Connecticut, New York, places of that location.

If we wanted to -- well, this plot shows the story that we think is important to show -- if we wanted to demonstrate, for example, that maybe nitrate was hitting Iowa, we could have picked a real low concentration interval.

But I'm not sure if that sort of manipulation of graphics serves any real useful purpose here.

We're showing where the impact of sulfur and nitrogen

emissions and anthropogenic sources in North Carolina really is. That's the purpose of this calculation and portrayal.

MR. FINE: Finally, in the series, I would ask that Ms. Shay display -- Your Honor, I beg your pardon.

We ask Defendant's 304 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 304 having been marked, was received in evidence.)

Q. I ask that Ms. Shay display Defendant's Exhibit 305, the last in the series in this sequence.

Dr. Tesche, I believe this is another one of our stacked bar charts?

A. Yes, sir.

Q. Similar certainly in concept to the one we looked at for sulfate deposition?

A. That's correct. This one portrays the nitrate deposition at the seven different National Acid Deposition Sampling Networks strung across North Carolina and in Virginia.

And this plot again shows the relative contribution of the Tennessee Valley Authority fossil plants showing green; the relative contribution of the North Carolina power plants in yellow, and anthropogenic sources, not just in North Carolina, but in the entire eastern U.S., the region that we're modeling.

You can see clearly that other anthropogenic sources are the predominant contributor to nitrate deposition at these seven sampling stations.

You also see, as we saw with the sulfate deposition, there is a geographical fingerprint, a geographical trend, showing that the component of Tennessee Valley Authority power plants attributing to nitrate, as small as it is, is largest on the western side of the state, and diminishes in magnitude as you go eastward.

That's sort of in the opposite direction of the modeled North Carolina power plant nitrate deposition.

These kinds of simulations, in addition to telling us about the spatial extent of, in this case, nitrate deposition flux, also help to confirm that the model is operating the way we would expect.

Because if we're going to control Tennessee power plants, for example, we would expect the controls to be manifest more at closer locations. It just makes sense. And that's what we see.

We also see, as I mentioned earlier, the large contributions from anthropogenic sources to these different sites.

MR. FINE: Ask that Defendant's Exhibit 305 be admitted.

THE COURT: That will be admitted.

(Defendant's Exhibit Number 305 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, ask that you display marked for identification Defendant's Exhibit 314.

Dr. Tesche, are you -- have you got that in front of you?

A. Yes, sir.

Q. Dr. Tesche, we're now moving to some of the graphical displays that you and your team generated from the 2013 modeling results; is that correct?

A. Yes, sir.

Q. And I believe that this is a CMAQ -- the display from CMAQ modeling program?

A. Yes.

Q. Is this for PM 2.5?

A. This is for annual PM 2.5 from the CMAQ model over the 12-kilometer grid, or the higher resolution, finer geographical scale grid of VISTAS and we used.

What this plot depicts is the estimated PM 2.5 concentrations across the southeastern United States in the year 2013 as the result of all projected emission control and growth programs in the United States, together with TVA operating at the levels of emissions set forth by Mr. Scott in the TVA plan.

Q. This also includes the controls from the North Carolina

Clean Smokestacks Act?

A. Yes, sir. It includes the Clean Smokestacks Act controls on the North Carolina power plants.

This is an overall picture. What is -- you know, look at 2013 as a baseline. Maybe I should state that again.

If you look at 2013 as the baseline run for fine particulate, this is the result from the CMAQ model.

If all of the emission controls that are projected to be in place by VISTAS in the states like North Carolina, and all those folks involved in VISTAS and ASIP, if those controls were to be implemented in the year 2013, together with the controls in California, and Nevada, Oregon, and all the other states in the United States that sit in the 36-kilometer grid that is apparent to this one, this is the predicted PM 2.5s concentration that would occur, the annual averages throughout the eastern United States.

And what you will see in the State of North Carolina is that there are no projected grid cells where the concentration exceeds the national ambient standard for PM 2.5.

Q. Which is 15?

A. 15 micrograms per cubic meter.

Q. You may have anticipated me, Dr. Tesche, because I was going to ask you why you selected the scale that you did with the zero-to-15 increment in gray or white?

A. Well, the purpose of this plot was to isolate those geographical areas within the eastern United States that are modeled to be in nonattainment -- let me not say nonattainment, because that's a regulatory declaration -- but modeled to be above the concentration levels associated with the PM 2.5 national standard, 15.

So what we wanted to show geographically on the page here was, where are there projected PM 2.5 attainment problems in the year 2013.

Q. Are there any such problems in North Carolina?

A. According to the CMAQ model and data sets we use, the answer to that question is no.

MR. FINE: I would ask Defendant's 314 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 314 having been marked, was received in evidence.)

MR. FINE: Ms. Shay and Dr. Tesche, if I could turn your attention and ask Ms. Shay to display Defendant's Exhibit 315.

Sir, once again, we're looking at 2013?

A. Yes, sir.

Q. And we're looking at a scenario under Mr. Scott's projections for TVA emissions?

A. That's correct.

Q. And we're also looking at a scenario that takes in the controls from North Carolina's Clean Smokestacks Act on its own utilities?
A. We're looking at two different computer simulations here.
Q. I beg your pardon?
A. This is a difference plot based on CMAQ that portrays the difference between a 2013 baseline simulation and a second run in which we zeroed out TVA fossil plants.
Q. Let me assure that I understand what you are saying, telling us, Dr. Tesche. This is a zero-out plot?
A. That's correct.
Q. And it's zeroing out the TVA fossil fleet from the levels predicted by Mr. Scott for TVA's 2013 emissions?
A. Yes.
Q. So this would be the maximum particulate matter reductions for 2013 if we shut down the TVA system, as opposed to running it, according to Mr. Scott's projections?
A. Yes, sir.
Q. What is this exhibit marked for identification 315 showing us about that?
A. Well, it shows that the geographical extent of PM 2.5 associated with TVA power plants is confined mostly to the central portion of Tennessee, with some impacts extending into Kentucky, as you would expect, because of the TVA

facilities, there as well as northern Alabama.

You can see the signature of some of the eastern TVA power plants there in light blue, suggesting a PM 2.5 impact that's perhaps in the range of .3 to .5. The dark blue encompasses a range of .1 to .3 micrograms per cubic meter.

We see that concentration range is predicted to occur across the North Carolina border, and penetrating a third of the way into the State of North Carolina.

This is a zero-out run, I would remind us, which is a worse case -- it is a hypothetical, but it's a worse case bounding estimate of the maximum possible impact that CMAQ model would suggest on PM 2.5 due to this strategy.

Not due to the strategy; due to this hypothetical simulation.

Q. What's the -- if you can tell us, what's the largest possible benefit to North Carolina from this zero-out scenario?

A. My recollection is that peak concentration is .48 micrograms per cubic meter.

I need to back up on that.

That doesn't square with my visual interpretation of the concentrations on this plot. I have to amend that by saying, I don't recall the exact numbers. Those numbers are in our expert report.

But by looking at the color contours here, I feel more

confident in saying that the impacts are in the range of .1 to .3 micrograms per cubic meter, since I don't see any light blue in the State of North Carolina across the border.

Q. Dr. Tesche, again, if you could just look at the scale that's on the left side of the figure marked for identification as Defendant's 315.

And I've asked you, sir, what were the considerations that lead you to the considerations of this particular scale?

A. There are 10 color bars there. And they describe a concentration variation that goes from zero up to 1 micrograms per cubic meter.

The standard is 15. We picked these numbers to present these results in as meaningful a fashion to the reviewer and decision maker as we could.

We can't have selected a different scale, for example, 1 to 15, the standard. In which case, each increment would be 1.5 micrograms per cubic meter. And if we were to have taken that approach, you wouldn't see anything on the plot.

So we picked a scale that tells the story. We have a cutoff here of .1 micrograms per cubic meter. That's half of the CAIR significance level that EPA declared in their CAIR modeling.

It's about a fifth of the precision or threshold of current, in the field, PM 2.5 monitors. And it seems to

encompass the range of where most of the impacts from this hypothetical experiment occurred.

MR. FINE: Your Honor, I would ask Defendant's Exhibit 315 be admitted into evidence.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 315 having been marked, was received in evidence.)

MR. FINE: I would ask Ms. Shay and Dr. Tesche to please direct their attention to Defendant's Exhibit 316.

I'm assuming this is sort of a companion plot to the one we looked at in 315, except zeroing out North Carolina power plants?

A. Correct. This is a bounding calculation, which I talked about for TVA, which we zeroed out in the CMAQ model, the emission for 2013. And we plotted this information in a scale that I believe allows the analyst to see the core features of the simulation results.

It shows a cloud of PM 2.5 increments that would be associated with full zero out of the North Carolina power plant fleet.

We see that the concentrations range from, at least the colored contours, from, say, .1 up to .8 or so.

The actual maximum in, looks like central North Carolina, coming from the South Carolina border north. The maximum is 1.2, somewhere in that string of high PM 2.5

concentration predictions.

PM 2.5 concentration increments in this bounding calculation above .3 or .4 extend into Virginia, more noticeably extend into South Carolina. There is a modeled impact of PM 2.5 from the North Carolina EGU's in Tennessee, extending past the mountainous region, or extending past the border of the two states westward, and concentration increments on the order of .1 to .2 or .3.

MR. FINE: I would ask Defendant's Exhibit 316 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 316 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, if you would please display Defendant's Exhibit 317.

Dr. Tesche, do you have that exhibit before you?

A. Yes, sir I do.

Q. What are we looking at here, sir?

A. What we're looking at here is a residual plot of the difference between the two future year power plant runs that I've been talking about in my testimony.

To reiterate very briefly, there is a 2013 baseline run. I think Mr. Chinkin and Wheeler talked about a 2000 -- excuse me -- yeah, 2013 baseline.

And that baseline consists of implementation of all the

growth and controls around the U.S., and especially the southeastern U.S., set forth by VISTAS, and the states to be in place by 2013, the best estimate of what emission levels will be in the year 2013.

For the base case simulation, we have assumed -- excuse me. For the TVA plan, we have assumed that the North Carolina fleet for power plants will be operating at the Clean Smokestacks level. That's what they propose in 2013. The TVA plan, we assume what Mr. Scott has set forth in his testimony, as the best projection of emissions from the TVA sources.

For the Clean Smokestacks simulation, a control simulation -- control simulation is what Chinkin and Wheeler call that scenario -- we have assumed that both TVA and North Carolina power plants will be operating at levels consistent with the Clean Smokestacks Act.

And to develop the emission rates for the TVA sources, we used the information they provided, their estimates of the Clean Smokestacks Act.

Q. Who provided?

A. They were provided to us by the table of the Chinkin and Wheeler report, which was given to them by Dr. Staudt.

Q. This is comparing the TVA plan emissions, as projected by Mr. Scott, contrasting that with emissions that are projected by Dr. Staudt, Mr. Chinkin and Mr. Wheeler?

A. There's more to it than that. The emissions that Mr. Scott provided for TVA facilities correspond to best projections of what's going to be in place for those power plants in the 2013 time frame.

Emission levels that Dr. Staudt provided for the TVA power plants were estimates -- were his statement of what the emissions would be from the TVA power plants in the year 2013, but not taking into account any of the controls on existing power plants that are poised to begin operation or that are under construction right now or reflecting fuel switches.

Mr. Scott addressed this matter in great detail. I don't think I need to go through it.

The bottom line here is that what this simulation is presenting is two future year simulations. We're looking at the effects solely in 2013 of the best estimates for the TVA plan as compared with the Clean Smokestacks Act plan applied to both fleets.

Q. And what is the result of that comparison as demonstrated by the information presented in marked for identification Defendant's Exhibit 317?

A. The result of that future year simulation is presented here graphically and numerically on a report.

What this report is showing is the difference between the two simulations in micrograms per cubic meter.

The blue color, which is a negative concentration -- note that our scale goes from zero to minus one.

What that means is that in every instance you see on this page, the additional Clean Smokestacks Act controls applied to TVA sources would produce a lowering of PM 2.5 concentrations of a magnitude expressed by the plotting scale here.

So in the dark blue we see that there would be a lowering of PM 2.5 associated with additional controls on TVA sources on the order of .1, 2.2, maybe as much as .4 micrograms per cubic meter. This plot shows that those reductions would all be occurring west of North Carolina's borders.

Q. What sort of reduction are we talking about within North Carolina's borders?

A. I would need to go back to my expert report to get that exact number. But that number is substantially less than the .1-micrograms-per-cubic-meter threshold that is presented on this plot.

My recollection is that number is .065 micrograms per cubic meter.

And if my memory serves me correctly -- and I have to say that we've got a lot of numbers here, and gosh, I wish I could remember all of them, but I don't.

If my recollection is correct, that incremental impact

of .065 occurs in a grid cell -- I think I mentioned earlier that it is co-owned by Tennessee and North Carolina. Two thirds is in Tennessee, a third is in North Carolina.

Now when I give you that number .065 -- and I believe that's a correct statement of the North Carolina impact here -- I'm not declaring that the precision of the model is out to three decimal places. I'm not declaring that. I'm presenting that number simply as a result that we have out to three decimal places that suggest the magnitude of the result.

When we're comparing control strategy results for ozone or other species where there are several different control scenarios being examined, we will sometimes give emission or ozone or PM differences to two or three decimal places, if only to help us differentiate in our minds, between one control simulation and another.

EPA has done that in their CAIR technical support document, where they give a tabulation of the PM 2.5 from the CAIR modeling out to two decimal places.

And I don't believe that's because EPA necessarily believes that the CMAQ model that they used is accurate to two decimal places for PM 2.5. The monitoring threshold for ozone -- or excuse me -- for PM 2.5 is .5 micrograms.

But it helps differentiate between, say, one state and another. In this case it helps us differentiate areas where

there is higher impact that tells the story that we think needs to be told and plot -- and those areas where the concentration levels are lower.

MR. FINE: Thank you, Dr. Tesche.

Your Honor, I ask Defendant's 317 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 317 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, please display Defendant's Exhibit 318.

Do you have that in front of you, Dr. Tesche?

A. Yes, sir, I do.

Q. Dr. Tesche, based on the education I have received from you and the others in this case, this appears to be a PSAT plot from the CMAQ modeling program. Would I be correct in so stating?

A. Yes, sir. The tipoff is the word "scaled" in the plot. We did not do a PSAT for the year 2013. We simply ran out of time.

But what we were able to do was to scale the source, a portion of results we generated for 2002, an example of where our modeling in 2002 bore direct fruit for our analysis in 2013. We were able to scale those results to build upon the body of knowledge we had developed with the 2002 modeling, to have an understanding of what impacts

might be from TVA power plants in the year 2013, based on the change in emissions from those TVA power plants in Alabama going from 2002 to 2013.

And this plot gives an estimate of what the impacts would be simply from the Alabama power plants.

Q. This scaling exercise you've mentioned, what does it entail, in brief terms?

A. Well, essentially it builds upon the recognition that sulfate and SO2 emissions are approximately, approximately linear in the atmosphere.

That is, if you were to reduce a source of emission of SO2 by 50 percent, the downwind sulfate impacts might be reduced somewhere on the order of 50 percent or maybe less.

There is a -- sulfate is a -- reacts nonlinearly in the atmosphere with the same chemistry that forms ozone and other particulate species.

But to first approximation, sulfate is a pseudo-linear species. In fact, that's one of the justifications EPA has for using their output model for Best Available Retrofit Technology, or BART, control programs on individual large sources of air pollution.

So we use that linear, or pseudo-linear sulfate of SO2 and sulfate, to scale our CMAQ PSAT results from year 2002 that I discussed earlier, to scale them up to the year 2013 to make an estimate of what the PM 2.5 impacts would be

associated with the Alabama plants. Because we had done PSAT modeling specifically for the Alabama TVA plants.

Q. Dr. Tesche, this is a question I probably should have asked earlier. What is the contribution of sulfate to PM 2.5 in this region?

A. That's going to vary from one monitoring station to another. Maybe one way to offer a start of an answer is to say that one of the themes of the VISTAS program with respect to visibility and with respect to deposition was, that in the southeastern United States, at least, it's a sulfate story.

What that slogan says is that sulfate is the predominant secondary aerosol species of major importance in the southeastern United States.

And nitrate is certainly important and elemental carbon and the other secondary particulates are important because they contribute to PM 2.5.

And as Dr. Tombach will speak to, each of those species have different effects in modifying light transmission, and hence visibility.

But in the southeastern United States, the first approximation, sulfate is the primary contributor to PM 2.5.

So capitalizing on the pseudo-linear relationship between SO2 emissions and sulfate concentrations, we were able to devise a simple scaling method that mapped, if you

will, our CMAQ PSAT results for the Alabama, the Kentucky and the Tennessee power plants, and the North Carolina fleet to year 2013 levels, to get an estimate of what these individual geographical subregions of power plants might contribute to PM 2.5 in the year 2013.

Q. The sort of scaling exercise that you describe here in your testimony, is that something that's routinely performed by professionals in the atmosphere modeling field?

A. I wouldn't say it's a routine -- a routine method. I would say that it builds upon the understanding of the role of sulfate in fine particulate.

It reflects the awareness that nitrate aerosol in the atmosphere is more nonlinear than sulfate. And hence, you are on much thinner ice to attempt any scaling of nitrate. And we didn't try that.

We instead implied a conservative factor of doubling the nitrate results to accommodate the smaller contribution of nitrate when we were coming up with our 2013 PM 2.5 estimates.

Q. Let me ask it this way, Dr. Tesche. Is this an acceptable method within the modeling community?

A. I'm not sure that I can honestly answer that. I don't know that the modeling community has ever been queried on this particular subject. But I would say that I would have confidence in going before a scientific symposium and

presenting these results.

Because the attempt was to estimate the downwind geographical extent of PM 2.5 in a future year, associated with individual comparing of power plants.

Because we didn't model that directly in 2013, power plant by power plant with PSAT. We did that in, obviously, in the base case.

I think this would be a -- an approach that I would present, professionally, at a national conference. I have that degree of confidence in it. We built in a conservative factor two scaling to boost the results to reflect the fact there are nonlinearities and not in this scaling method accounting for some of the other smaller components of PM 2.5 here.

Q. With that as an introduction, Dr. Tesche, could you tell us what Defendant's marked for identification as 318, what information does this convey?

A. What this plot tells me when I look at it is that the region of primary influence of the Alabama power plants for PM 2.5 in 2013, that is in the 2013 atmosphere, where the composition is determined by the chemicals emitted by all the sources operating in the region under 2013 emission levels, that the contribution of those power plants in Alabama would be on the order of .05 up to maybe .2 or .4 micrograms per cubic meter.

Q. And what sort of impact do you see from these plants in North Carolina?

A. There's a little bit of blue in North Carolina, in the extreme southeastern portion of North Carolina in, say, the .05 to .1 concentration range.

And it's reasonable to expect that the -- there will be concentration impacts farther east in North Carolina below .05 micrograms per cubic meter.

These spatial fingerprints of the clouds sort of drop off, as you go away, with distance.

I don't have in my mind the extent to which those incremental effects would go.

MR. FINE: Thank you.

Your Honor, I would ask the Defendant's Exhibit 318 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 318 having been marked, was received in evidence.)

MR. FINE: I would ask Ms. Shay to display Defendant's Exhibit 319 marked for identification.

Dr. Tesche, do you need more water? You have your own bottle.

A. I snuck some up here.

I have that exhibit in front of me.

Q. And Dr. Tesche, assume this is once again the scaled

PSAT results for PM 2.5 in 2013 for TVA power plants in Kentucky?

A. Yes, sir. That's what this exhibit is.

Q. And what impact does this show in North Carolina?

A. Well, this plot, because of the scaling that we have used, going from zero to .05 micrograms, doesn't tell us if there is variation in -- or if there are impacts in North Carolina. If there are, they are below 0.5.

The difference between blue plotting and the border of North Carolina suggest to me that the impacts, if they occur in North Carolina, in this situation from the Kentucky plants, are going to be pretty darn small. Most of the impact is centered along the lower reaches of the Ohio River in the region formed by Kentucky, Indiana, Illinois, Missouri and Arkansas.

The peak impact is .16 from PSAT, and this is due to the TVA power plants in Kentucky.

MR. FINE: I would ask that Defendant's 319 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 319 having been marked, was received in evidence.)

MR. FINE: Next in this series, Dr. Tesche and Ms. Shay, we have Defendant's Exhibit 320.

And again, I believe this is the scaled PSAT

results for 2013 for PM 2.5 for the TVA's Tennessee plants, correct?

A. That's correct. That's right.

Q. And again, sir, if you could tell us what sort of impacts are shown from those plants in North Carolina.

A. In North Carolina we see that the color scaling here shows that the model is estimating concentration impacts that vary from .05 up to what would could be a concentration impact as high as .15 micrograms per cubic meter.

And that covers a number -- a number of the grid cells in western North Carolina.

MR. FINE: Your Honor, I would ask Defendant's Exhibit 320 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 320 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, if you would please display for identification Defendant's Exhibit 321.

Are you with me, Dr. Tesche?

A. Yes, sir.

Q. I understand. It's been a long day Dr. Tesche. We have some more territory to cover.

Dr. Tesche, I believe we've switched from particulate matter to ozone, correct?

A. That's right.

Q. And looking at marked for identification 321, what are we -- in brief terms, what are we looking at?

A. What we're looking at is a direct attempt to answer the question, what's the ozone impact associated with the two future year power plant control scenarios.

This plot shows the change in ozone concentration expected by the CMAQ model in the year 2013, as a result of different emission assumptions to the TVA power plant.

I alert you to a couple changes in this plot.

First, the concentration scale obviously is in parts per billion, goes from zero to 16, the old standard. The new standard is 75 parts per billion. So we're only looking at a fraction of the full range of the ambient standard.

Second, if you look at the bottom of this plot on the X Axis, you see a number 1 and 68. These numbers may not mean much to many reviewers, but it says to me that these results are for the 12-kilometer domain. The previous plots that we were looking at, the PSAT plots, were based on a 36-kilometer domain, a larger scale domain -- excuse me -- a domain that had larger grid cell sizes, but these plots, because ozone is a pollutant that has greater spatial variability, these plots are based upon the 12-kilometer CMAQ results, a finer resolution that follows directly the EPA guidance on how one does the modeling.

So, with that overview, what this shows is location of

projected impacts of additional controls sought by North Carolina on TVA power plants. These impacts in parts per billion are shown in this exhibit.

What you'll notice is there is some blue and little bit of light blue on the border of North Carolina and Tennessee. That suggests concentration impacts on the order of 2 to 6 parts per billion.

My understanding, my recollection is that the peak ozone impact in North Carolina that occurred, under this scenario, was 5.2 parts per billion.

Now, in this particular instance, because this was a future year simulation of the two power plant controls, we wanted to know what was the underlying concentration level existing in this region of Tennessee and North Carolina and Virginia for all sources.

That would be a very important question to ask, because it addresses the fact, is this increment on the border of North Carolina significant from the standpoint of possibly leading to an accedence of the concentration level of the federal standard.

And what we found by looking at the modeled concentrations from all sources in this region of North Carolina was, that the background concentration from all source impacts, all the anthropogenic sources, all the natural sources of air pollution, were such that they were

well below the federal standard.

We have archived and documented what those results are, and they're readily available in an array on hard disk.

But the point is that this increment of 5.2 PPB is occurring at a time and location where the total ozone from all sources to which this number would be added comes nowhere close to exceeding the level of national standard.

MR. FINE: Ask that 321, Defendant's Exhibit 321 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 321 having been marked, was received in evidence.)

MR. FINE: I would ask Ms. Shay to display Defendant's Exhibit 322.

MR. GOODSTEIN: Your Honor, we have objections to this one and the next one, because they weren't disclosed in Dr. Tesche's report and have been revised since then.

MR. FINE: Your Honor, I'll address that with Dr. Tesche as he describes this figure.

Dr. Tesche, I think we've switched at least a point of reference here in terms of the scale. This is again still talking about ozone. Would you just generally explain before we address some of Mr. Goodstein's concerns, what is this figure doing for us?

A. What this figure seems to do is describe,

geographically, the number of days across the southeastern United States, in the year 2013, for which the maximum ozone concentrations were greater than the level of the Federal National Ambient Air Quality Standard for ozone.

When we originally published this page, the National Ambient Ozone Standard was 85 parts per billion. We revised it because the standard has been changed. That's the only alteration to this plot.

The color on the scale doesn't change. I'm sorry. I have to take that back. I need to correct myself.

This plot depicts the number of days across the eastern United States where the concentration is greater than 75 PPB, the present standard.

I believe our previous plot showed similar results, but stratified it according to the former standard. This more-up-to-date plot is in sync with the present National Ambient Air Quality Ozone Standard of 75 PPB.

What we see in this plot is that there is a grid cell or two, hard to tell from the color there, whether one or two, in North Carolina or immediately downwind of the city of Charlotte, that is -- that has somewhere between four and eight days that would be above the level of the National Ambient Standard For Ozone in the year 2013. Now, there are a couple of points to mention.

In our original work, when the standard was 84 or 85,

there was no color plot, or no color on the plot for North Carolina, saying that all of North Carolina grid cells were below the concentration level of the former standard.

Here we have a few days that appear to be above the concentration level of the new standard.

Now, it's important to point out that this does not constitute a violation of the standard.

The air quality standard for ozone is based upon the fourth highest ozone concentration at an established regulatory monitor when averaged over three years.

This is a simulation of the highest, or the number of ozone days throughout a ozone season that would be above that concentration level. It's one year.

And so, let's take as an assumption that this is five days, let's say. If the fourth highest of those five days was above the level of the standard, then that one day would be an important day. We would need to go back and look at the previous two years to see if in that same grid cell in that same monitoring station, there were also high concentrations. But, obviously, this is 2013, so there isn't monitoring data.

The point is that this does not constitute a violation of the standard. It simply suggests that there were a handful of days at this location for the new standard for the models estimating concentrations above 75 PPB.

When we looked at it, the concentrations were somewhere between, as I said, 75 and 85 PPB.

Q. Dr. Tesche, the data that was used to develop this tile plot, is this new data or data contained in your prior modeling runs?

A. It's data in the same modeling run. It's just that when the standard changed and we wished to update our results to put them in sync with the new standard, we had to reprocess the data. And obviously a few more days got plotted here because that's what the output showed.

The concentrations are the same. The outputs didn't change. We just reprocessed the numbers.

Q. Did you share that data with STI, the underlying data?

A. Yes. Oh yes. No, they had our output plot. So they could have produced this plot and they could have picked a different color scheme or threshold if they wanted.

THE COURT: All right. We're going to let it in. That's 322.

Let's take a 15-minute recess then we will continue.

(Defendant's Exhibit Number 322 having been marked, was received in evidence.)

(Recess.)

THE COURT: All right.

MR. FINE: Thank you, Your Honor.

Ms. Shay, Dr. Tesche, if we could look at Defendant's marked for identification 323.

A. Yes.

Q. Briefly, Dr. Tesche, would you tell us what we're looking at in this document marked for Identification as 323?

A. Yes. The scale that we have here is percent change. It's sort of a different way of looking at things. But the plot contains the information about the change in the number of days that would be above the new federal ozone standard going from the TVA plan to more stringent controls on TVA power plants.

And the dots -- the red dots indicate that the number of days going from the TVA plan to the Clean Smokestack controls could vary anywhere from no change at all to 100 percent change.

Now, that 100 percent change may seem like a large number, but, in reality, it could be one day change if, the first run, there was only one day or two days that had concentrations higher than 75 PPB.

So the change in the number of days that may exist by going to more stringent controls is pretty limited across the State of North Carolina.

This metric is important because when you're doing a demonstration for 8-hour ozone, by EPA guidance, you have to

have a fairly large number of days with which to compute the design value for attainment.

What this is showing is that the more stringent controls doesn't really change the number of high ozone days that would necessarily go into that kind of a calculation.

So the more stringent controls don't really change in any large measure than the number of days, although, locally, some percent might change by what looks like a big number.

MR. FINE: I would ask that Defendant's Exhibit 323 be admitted.

MR. GOODSTEIN: Same objection, Your Honor. It has been revised since it was disclosed.

THE COURT: Overruled. 323 is admitted.

(Defendant's Exhibit Number 323 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, I'm not going to ask you to display the next in order.

I'm going to take these as a group, Dr. Tesche. I'm going to take these as a group.

Dr. Tesche, if you could please look at Defendant's Exhibit 324, 325, and 326.

A. Yes, sir. I have these.

Q. And could you just tell us what this collection of documents marked for identification exhibits -- what is this

displaying?

A. What these three exhibits show are the contributions to 8-hour ozone, day-by-day, at three representative monitoring stations across the State of North Carolina. These would include Great Smoky Mountains on the west, Charlotte, in the central portion of the state, and Raleigh, in the eastern part of the state.

Let's focus for the moment to describe the plot on Exhibit 324, which is the ozone plot at the Great Smoky Mountains National Park monitoring site.

There are three curves here and a red dot-dashed line. We're plotting ozone concentrations from zero to 80 parts per billion on the ordinant or Y Axis, and days from the beginning to the end of ozone season. This is a plot for the year 2013. But the meteorological conditions, of course, are for the base year 2002.

The three traces respond to the ozone concentrations generated by either the TVA power plants, by the North Carolina fleet, and by all the other anthropogenic sources in the region.

The total ozone at North Carolina on any given day would be determined by the sum of the three concentrations -- or the concentrations described by these three lines.

Two things pop out immediately when you look at this

plot. First, none of the individual plots go over the dash line, which is the level of the new Federal Ambient Ozone Standard, which is 75 parts per billion.

Second, the contributions of the North Carolina and TVA power plants to ozone at the Great Smoky Mountains monitor during the summer ozone season is essentially lost in the weeds, as we say.

These concentrations, the blue and green lines, are way down the bottom of the page, sort of hugging the horizontal axis.

There is day-to-day variation for sure. And if you look at the second and third plot, Exhibits 325 and 326, you'll see that not only is there day-to-day variation, but the variation for all three curves changes as you go in different monitoring stations across the State of North Carolina.

Bottom line here is that the contributions of the TVA and the North Carolina power plants to 8-hour ozone at these three monitors is quite small, relative to the contribution of other anthropogenic sources.

And in most cases, the combined effect of all three of these source categories is to produce peak concentrations that do not exceed the level of the national standard, that is, the red dashed line. There are some instances that they do, but those are only on a few days, most notably on the

Charlotte model.

Q. Again, this is 2013 projections?

A. Yes, sir. 2013.

MR. FINE: Your Honor, I ask that Defendant's Exhibits 324, 325 and 326 be admitted.

THE COURT: All right. Let those be admitted.

(Defendant's Exhibit Number 324, 325 and 326 having been marked, were received in evidence.)

Q. (Mr. Fine) And in the same, somewhat summary fashion, Dr. Tesche, I would ask that you take a look at the next series of exhibits, Defendant's Exhibits marked for identification 327, 328, and 328 (sic).

A. Yes, sir. I have these.

Q. And I believe this is information relating to sulfate deposition?

A. Yes, sir.

Q. And on 327, what are we looking at?

A. 327 is a CMAQ simulation in which we have zeroed out the emissions from the Tennessee TVA power plants. And we are plotting here, essentially, the maximum possible sulfate deposition that would occur in the region if we were to completely eliminate the North Carolina -- or excuse me, the Tennessee Valley Authority power plants.

The deposition is centered around central Tennessee and west central Kentucky. The maximum deposition amount is 22

kilograms per hectare. When we analyze the underlying data files, we determined that the maximum deposition in the State of North Carolina, maximum possible deposition, because this is a zero-out run -- maximum deposition from Tennessee Valley Authority power plants in North Carolina is 2 kilograms per hectare.

Q. And 328 is a zero-out exercise for deposition sulfate in the North Carolina power plants?

A. That's correct. It's the companion plot that shows a somewhat smaller footprint of the deposition. The maximum deposition rate, though, is -- let me check that statement or retract that.

The maximum deposition in North Carolina is 10 kilograms per hectare, as opposed to a maximum of 22 in Tennessee from the TVA power plants.

Q. But I would be correct in stating that 10-kilogram impact is in North Carolina?

A. It's mostly North Carolina. Looks like there's a little bit touching South Carolina and Virginia.

But you're right. This plot shows that virtually all of the nitrate -- excuse me -- the sulfate deposition comes in from North Carolina EGU's -- excuse me -- EGU zero out, occurs within the state.

MR. FINE: I would ask that Defendant's Exhibits 327 and 328 be admitted.

THE COURT: Okay.

(Defendant's Exhibit Number 327 and 328 having been marked, were received in evidence.)

Q. (Mr. Fine) We can briefly touch on Defendant's Exhibit 329?

A. Yes, sir.

Q. This is another one of our stacked bar charts?

A. Yes, sir.

Q. And what is this showing us, Dr. Tesche?

A. There are a handful of monitoring stations here, essentially from west to east. And the plot is showing the relative contribution of the North Carolina and the Tennessee Valley Authority power plants, as well as all other anthropogenic sources, on sulfate deposition at these various deposition monitoring network stations.

The overwhelming contributor to sulfate deposition, as you see here in the dark blue, is from other anthropogenic sources.

TVA sources, in green, show their greatest effect, even though it's quite small, on the western-most deposition monitors, in particular Joyce Kilmer, extending to smaller concentration impacts as you get farther towards the east.

As we saw with -- in earlier plots of this nature, the contribution from North Carolina power plants begins to become larger as you move farther east, closer towards the

predominant North Carolina EGU system.
Q. Again, this is data based on TVA's projections for its 2013 emissions?
A. Yes. Yes.
MR. FINE: I would ask that Defendant's Exhibit 329 be admitted.
THE COURT: Let it be admitted.
(Defendant's Exhibit Number 329 having been marked, was received in evidence.)
Q. (Mr. Fine) Dr. Tesche, if we can look at, very briefly, Defendant's Exhibit 330.
A. Yes.
Q. And what information is this displaying?
A. This plot shows the difference in the two future-year power plant scenarios, the 2018 baseline.
Q. 2000 and which, sir?
A. Thank you. 2013 baseline, which has the TVA and the North Carolina power plant fleets running at the Clean Smokestacks control level and the 2013 baseline -- excuse me.
The 2013 baseline which has the Clean Smoke -- the North Carolina power plants running at the Clean Smokestacks and the TVA power plants running at their 2013 plan, compared with the more stringent controls on the TVA in the same set of controls in North Carolina.

What this plot shows is that the sulfate deposition is confined, largely, to the State of Kentucky and to Tennessee. There's a little bit of sulfate deposition that's occurring in north Alabama.

The concentrations are low; the deposition fluxes are generally low. They're in a range of, say, 2 to 4 or so kilograms per hectare.

There's an interesting feature on this plot, the red dot and the yellow, and that is an indication of an artifact -- not an artifact in the modeling, but a misrepresentation of the emissions from the Paradise power plant by Chinkin and Wheeler in their listing of the emissions from that facility, and that's reflected in this ominous looking deposition signature.

Q. Is that based on an overstatement of Paradise's emissions from sulfate --

A. Yes.

Q. For SO2?

A. Yes. They overestimated the SO2 concentrations from that facility.

MR. FINE: Ask that Defendant's Exhibit 330 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 330 having been marked, was received in evidence.)

Q. (Mr. Fine) Again, if we can look at Defendant's Exhibit 331 for identification, Dr. Tesche, and ask if you can tell us what this document is showing.

A. This is the projected sulfate deposition at the Class 1 areas across the State of North Carolina and Virginia in the year 2013. And it shows, side-by-side, the TVA plan versus the Clean Smokestacks plan.

What you will see here is that the deposition impacts from the two plants vary, a little bit, from one deposition monitor to another.

But the -- overall, the two plants are very comparable in their effect on sulfate deposition at these various deposition sites. Not a great deal of change from one power plant scenario to another.

MR. FINE: I would ask Defendant's Exhibit 331 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 331 having been marked, was received in evidence.)

Q. (Mr. Fine) Dr. Tesche, if we could take Defendant's Exhibit 332 and 333 and 334 as a group, sir?

A. Yes.

Q. And correct me if I'm wrong, but these appear to be the analogous tile plots for the ones we were just looking at for sulfate, but this time for nitrate deposition?

A. That's correct. The first plot, Exhibit 332, shows the TVA facility or TVA power plants' contribution to nitrate deposition in the future year 2013. And most of that is confined to within the States of Tennessee and Kentucky.

However, there is a -- the model did predict a small amount of deposition on the order of .2 kilograms per hectare in the State of North Carolina, as I recall.

Q. Then 333 would be the North Carolina -- zeroing out the North Carolina power plants for nitrate deposition?

A. Yes. 333 is the companion plot for the North Carolina EGU showing the deposition in the future year 2013. And the maximum deposition is .9 kilograms per hectare. We plotted that on a scale of zero to three. And we see that there is some nitrate deposition in the States of Virginia, and just on the border of South Carolina, as well.

Finally, Exhibit 334 is the stacked bar chart showing the same monitoring stations, the deposition monitoring stations across the State of North Carolina and Virginia.

Again, comparing and contrasting the deposition contributions from the two power plants scenarios -- or excuse me -- the North Carolina fleet and the TVA fleet as opposed to all other anthropogenic sources.

As with sulfate, the nitrate results show that the power plant contributions from the two fleets is quite small, relative to the other source categories.

The deposition totals are in the range -- from all sources, are in the range of say 4 to 12 kilograms per hectare, depending upon which monitor you're looking at.

The TVA sources have their greatest impact even though it's very small, on the western most monitors in North Carolina. Whereas the North Carolina power plants have their greatest impact, again very small, on the eastern part of the State.

MR. FINE: I ask that Defendant's Exhibit 332, 333 and 334 be admitted.

THE COURT: They will be admitted.

(Defendant's Exhibit Number 332, 333 and 334 having been marked, was received in evidence.)

MR. FINE: Ms. Shay, if you would please display Defendant's Exhibit 335.

If I could ask Dr. Tesche to turn to that, please?

A. Yes, I have this figure.

Q. What are we looking at here, Dr. Tesche?

A. This is a composite plot, or a plot showing the overall nitrate deposition projected to occur in the year 2013.

Assuming that the both the TVA fleet and the North Carolina fleet are operating under the provisions of the Clean Smokestacks Act. And what you see is that there is nitrate deposition across a good -- well, all of the eastern United States as shown in the VISTAS 12-K grid.

The highest values seems to occur in the mountains triangle of West Virginia.

In North Carolina, the deposition from all sources from the eastern United States, appears to be in the range of say 3 to 2, perhaps, 8 or 10 so, something in that range, 5 to 8 kilograms per hectare.

The maximum concentration is 19 kilograms per hectare in the West Virginia mountains just south of Wheeling -- or excuse me, just south of Senior Hill, Pennsylvania.

Q. How does this compare to the deposition patterns from nitrate deposition under the TVA plan?

A. They're virtually indistinguishable.

MR. FINE: I would ask that Defendant's Exhibit 335 be admitted.

THE COURT: Be admitted.

(Defendant's Exhibit Number 335 having been marked, was received in evidence.)

Q. (Mr. Fine) And again, looking at next in order, Defendant's Exhibit 336, Ms. Shay if you would please display that?

A. This is -- this plot, Exhibit 336 is a difference or a residual plot showing the net effect of the Clean Smokestacks Act, additional Clean Smokestacks Act controls on the TVA power plants in the year 2013.

And what you see here is -- and this really is a

deficit enhancement plot, because in some areas, particularly over extreme western North Carolina, especially Tennessee, you see a negative concentration, a slight deficit.

And what this green represents is areas where the total annual nitrate deposition, as a consequence of additional controls on TVA power plants, would be reduced.

The flux of nitrates to the ground surface would be reduced by a small fraction as shown in green, from minus .05 to minus .1 kilograms per hectare.

I can't recall off hand what the increment is in North Carolina, but it's colored gray here. And so it would be between zero -- excuse me -- between -- yeah, between zero and minus .05.

There are other areas in the -- west of the Mississippi and westward there that show yellow, which would be a slight deposition increase as the result of the controls.

MR. FINE: Ask Defendant's Exhibit 336 be admitted.

THE COURT: It will be admitted.

(Defendant's Exhibit Number 336 having been marked, was received in evidence.)

Q. (Mr. Fine) Finally in this series, Dr. Tesche and Ms. Shay, if you would please display this, I direct your attention to Defendant's Exhibit 337.

I believe this is a companion piece to a bar chart that we looked at in relation to sulfate deposition, is it not?
A. Right. This plot shows, side-by-side, the effects of the TVA plan versus the Clean Smokestacks plan on annual nitrate deposition on the numerous monitors that we have looking at the deposition network across North Carolina and Virginia.
And you can see there that there certainly is variation from one monitor to another, but there doesn't seem to be any appreciable -- any appreciable or any discernible difference between the two power plant control scenarios in the year 2013.
MR. FINE: Ask that Defendant's 337 be admitted.
THE COURT: Let it be admitted.
(Defendant's Exhibit Number 337 having been marked, was received in evidence.)
MR. FINE: Ms. Shay, if you would please display Defendant's Exhibit 338.
Do you have that in front of you, Dr. Tesche?
A. Yes, I do.
Q. What are we looking at here?
A. This is a table that summarizes in one place, and I think in a convenient format, some of the bottom line results we have in looking at, in the year 2013, the impacts from the Tennessee Valley Authority power plants on

receptors in North Carolina, and, similarly, the impacts of North Carolina EGU's on receptors located in Virginia.

What this gives an example of is the contribution of a particular state to a neighboring state for annual PM 10, annual PM 10 ozone, both on a 1-hour and 8-hour basis. Sulfate and nitrate deposition.

The second column actually lists the contribution being made by the TVA power plants in the year 2013, under the proposed TVA plan, the level of emissions they are projecting to abide by, compared with the third column, which is North Carolina's impact on Virginia and South Carolina, the next one.

What we see is that the impact that TVA is having on North Carolina is, in every instance, smaller than the impact that North Carolina power plants are having on their neighboring State of Virginia. And, similarly, the same picture holds true for the impact in North Carolina on South Carolina.

So these results would suggest, on the basis of the CMAQ modeling for the future year, that the impacts that Tennessee Valley Authority power plants are having on their neighbor are smaller than the impacts that North Carolina is having on its adjacent neighboring states.

The last column provides a ratio of the maximum exported North Carolina impact to the TVA's impact in North

Carolina. So it's a quantification of the relative export to a neighboring state.

That ratio is above one, which means that North Carolina, in 2013, for the particulate -- excuse me, for the chemical species, the air pollutants listed in column one, contributes more to the other two states than Tennessee Valley -- excuse me, than the Tennessee Valley plants contribute to North Carolina.

MR. FINE: Ask that Defendant's 338 be admitted.

THE COURT: Let it be admitted.

(Defendant's Exhibit Number 338 having been marked, was received in evidence.)

MR. FINE: And if I could ask Ms. Shay to display Defendant's Exhibit 339.

A. Yes, sir.

Q. As an initial matter, Dr. Tesche, could you explain where the information in, marked for identification, 339 comes from?

A. This information comes from the CMAQ modeling in the year 2013 on a 12-kilometer grid, which is the VISTAS grid that we used in this application.

Q. This was information contained in your modeling runs that were shared with STI?

A. Sir, I've drawn a blank.

Q. All right, sir. That's fine, Dr. Tesche. We'll just

pass the matter.

A. Okay. I apologize. If I could be directed to relevant sections in our reports, but I, frankly, have drawn a blank on the origin of these numbers.

MR. FINE: I would ask Ms. Shay to remove the document from the viewer.

A few more items of information I would like to cover with you Dr. Tesche. These will not be contained in Defendant's Exhibit Notebook 13. They come from other sources. And I would be requesting Ms. Shay's assistance to display them for all of us on the viewer.

I would like to start with a document already introduced into evidence as Plaintiff's Exhibit 139, just the first page of that.

And as the caption indicates, Dr. Tesche, this is one page from the Inert Tracer Tile Plots generated by STI as part of Mr. Chinkin and Mr. Wheeler's presentation?

A. Yes, sir. That's correct.

Q. Sir, what is the -- what is an inert tracer exercise?

A. May I ask you to clarify that question, please?

Q. I will try, sir.

In the modeling community, what is the proper use for inert tracers?

A. Tracer species are used, in my experience, in two general ways in the modeling community.

In one particular method -- and it's an area that I've got considerable experience in -- the model is exercised with a known amount of tracer material emitted from a known location, maybe several locations. And it is sampled downwind in the real atmosphere. It is sampled with monitoring equipment downwind.

In the model, the model is asked to predict concentrations at those downwind locations where samples were put out into the atmosphere. And then the model is evaluated for it's ability to replicate the trace material.

So in one sense, tracers are used in modeling to compare with the measurements of tracer species.

And it's one way to test the dispersion characteristics of the model, because the confounding processes of chemistry are not present.

Tracer experiments have been used historically in the United States and abroad to simulate local and regional transport of materials.

In those simulations, the physical characteristics of the species that's being used as a tracer, sulfur hexachloride, which has the initials SF6, freon, and some exotic hydrocarbon species were all used as tracers.

And in the modeling, the molecular weight of those species are used to mimmick their proper bouyant or positive or negative buoyancy in the atmosphere. So that's one way

tracers are used.

The second way that tracers are used in modeling is to serve as mathematical surrogates to depict the transport of chemical species in a source apportionment algorithm, such as the PSAT or OSAT.

So, in that context, tracers are used in the air quality models to help support the source apportionment algorithms. The tracer species themselves are not output. They're simply carrier parameters in the models that help the source apportionment algorithms.

Both of those methods are quite distinct from the method that Mr. Chinkin and Mr. Wheeler utilized and reported in their expert report.

Q. Let me pursue that for a moment.

Based on your review of Mr. Chinkin and Mr. Wheeler's report with their colleagues at STI, to what use were they putting this inert tracer exercise?

A. I cannot speculate as to their motivation, or at least I shouldn't.

I can only answer this question on the basis of what they said and what they showed in their report.

In their report, they said that they were using these inert tracer species to provide a -- an estimate of the potential for air pollution impacts from the TVA power plants; yet, nowhere in their report do I find any

identification of the kind of information you would need to have, if you were going to judge the adequacy or veracity of their calculations.

There's no indication of what the emission rate was that they put into the model at each of the TVA power plants. So we can't relate the emission rates at the TVA power plants to the downwind impacts to assess whether they're reasonable.

The plotting scales that they have chosen represent tracer impacts at concentrations that are extremely tiny, going up to concentrations that look like, on this scale, greater than 100 parts per trillion.

The scale is nonlinear in an attempt to show, or to sort of encompass the range of tracer impacts that are shown on this -- that they report in their plot.

My judgment of this information, if that's part of your question --

Q. It is, sir.

A. -- is that these plots, each one bearing a unique geometry, associated with the power plants that were examined here do a pretty reasonable job of showing, on an annual average, where the wind blows at the ground, not at the level that the power plants emit.

These are ground-level plots, as far as I can infer from Chinkin and Wheeler's report. This is where the

ground -- or the wind at the ground blows. Power plants emit at a much higher elevation.

Now, if perhaps Chinkin and Wheeler averaged their concentration over some depth in the boundary layer, then we might be able to say, yeah, this reflects a realistic portrayal of the boundary layer transported material.

I do know that they inject -- from what they say in their report, they injected this material in the plume of the power plants. So perhaps this does give an indication, at least for a while, of the wind direction that the plume might be taking.

But, overall, it's ambiguous as to really what -- what this is showing, in my mind.

Can I add one other thing?

Q. By all means, sir.

A. Okay. These are annual simulations. And in the annual simulations that I've done at hemisphere scale, what I know is that, if you follow inert particles, things that don't deposit, things that don't chemically react, things that don't change, except their concentration in the atmosphere, the atmosphere can transport these materials long distances.

In the VISTAS modeling, in our PM 2.5 analysis, we were seeing signatures of dust in the Sierra Desert at monitoring stations in North Carolina. If it can transport that far from east to west, when the winds, at least in the U.S.,

blow east to west, normally, it stands to reason that if we had -- if Chinkin and Wheeler had enlarged their scale, say, the 36-kilometer grid scale, had they chosen to model that grid and used even lower concentrations, they could have shown impacts in Canada or Maine, or, in the limit, Finland, if you wanted to go that far with the grid.

They never declared exactly how they used this information to guide their CMAQ modeling. They never provided the reader with any interpretation of what this meant, beyond the declaration that it shows the potential for impact.

Q. Dr. Tesche, I ask you to take a look at Plaintiff's Exhibit 140, and ask Ms. Shay to display that on the viewer.

Dr. Tesche, this is a screen shot from a movie presented by the plaintiff in this case through the testimony of the STI modelers.

I ask you, first of all, what is an isosurface.

A. An isosurface is a surface of constant stuff.

Q. Constant stuff?

A. Yeah, stuff. You might think of it in terms of an isotherm, a line of constant temperature; or an isovel, which is a line of constant velocity; or an iso bar, which is a line of barometric pressure.

An isosurface is a surface of constant stuff. I don't know if it doesn't -- it's not a concentration of a color.

It doesn't say it's an isosurface of a common elevation.

So I don't -- at least the information presented on the exhibit I'm looking at doesn't tell me, really, what I'm looking at, except I see a -- what looks to be a -- some sort of weather phenomenon blowing, a greenish weather phenomenon.

Q. Have you had occasion to view the movie that was presented by Messers. Chinkin and Wheeler?

A. Yes, sir. I viewed it several seatings.

Q. And what is your assessment of that movie, as represented in this screen shot of Plaintiff's Exhibit 140?

A. At one level, I found it sort of intriguing. It does show sort of the motion of material in the atmosphere from one location to another over a short period of time, much like, you know, when we sit in front of our television and watch the cloud patterns move on the satellite photographs, or the weather radar and all different graphical display.

So it gave a snapshot of, say, on the days that were captured in this 5-D plotting, sort of a transport of stuff across the southeastern United States.

What I wasn't able to learn from looking at this plot, and I looked at it several times, I wasn't able to discern really what it was I was looking at. The title talks about particles of SO2 that converts to sulfate. There's no color scale, really, that would differentiate between SO2 and

sulfate, or even tell me what the concentration levels would be.

I didn't see in the plot, at least it wasn't apparent in my viewings, any vertical scaling that would allow me to understand whether I was looking at the ground, aloft, or at some tilted view.

Furthermore, the plot, to me, was misleading because it was talking about TVA's SO2 emissions in transport. Today we've not talked about TVA power plants in Baton Rouge, and yet there appear to be sources down there that are contributing to an isosurface someplace.

So my suspicion is that there's more being animated here than just Tennessee Valley SO2 emissions.

There clearly are some signatures of individual point sources, as I mentioned. Louisiana; looks like something happening north of Tampa; and certainly in Alabama and western Tennessee. Other sources are obscured by the green, reddish-brown haze.

The animation in this screen shot just does not provide a reader with enough information to understand and make their own judgment as to whether it is meaningful or not.

And the authors of the report, Chinkin and Wheeler, did not offer a similar narrative description of, really, what it meant, what the concentrations were, whether they were, in fact, of a range that could be measured by measurements.

So I can only place this screen shot and the attendant movie as an interesting presentation. It just doesn't tell me much about air quality impacts.

Q. I would like to turn your attention to Plaintiff's Exhibit 143 and ask Ms. Shay to display that.

And if I could draw your attention principally to the right hand plot on Plaintiff's Exhibit 143. Do you see that, sir?

A. Yes, I do.

Q. And with that as a point of reference, Dr. Tesche, could you tell us whether weather patterns can serve to trace North Carolina impacts to particular TVA plants?

A. I think I understand the last part of your question: Can weather patterns predict the downwind geometry of plumes from Tennessee Valley Authority power plants?

Q. I think that's a fair restatement of the question, Dr. Tesche. If you could respond.

A. Okay. Weather patterns. Well, a weather pattern is a combination, in my mind, of one or more weather variables, such as wind direction or wind speed or boundary layer height, the height of mixing in the atmosphere, relative humidity or temperature, maybe several of those, a weather pattern, a geometry of flow.

But whether the -- W-H-E-T-H-E-R -- whether the signatures of the wind flow patterns and the clouds and

mixing heights mixing in the atmosphere can really tell us where pollution goes, I think, is a real stretch, because the levels at which emissions are introduced in the atmosphere, especially from fossil fuel power plants, may be occurring at a level in the atmosphere that's not typified by the weather pattern.

The surface winds do not necessarily blow -- in fact, don't blow in the same direction as winds at higher elevation, even above the elevation of power plants.

So a weather pattern, if one was defining it as a large scale pressure feature, doesn't necessarily tell you where pollution's going to go.

My studies in complex terrain in the mountainous region indicate the presence of rugged terrain, such as you have in the Appalachians, can redirect flows in the higher aloft that would change the transport patterns of plumes of manmade pollutants, such that the large scale weather patterns would give you a false understanding of where pollution is going.

In some cases, you know, in places such as in California, where there are very strong forcing of wind directions, those, Your Honor -- if you've been to Monterey and seen those trees that are constantly blown by the wind and all the vegetation on the upstream side is gone and it's bark and everything is blown that way, that kind of weather

pattern, supplemented by vegetation, can give you a pretty good guess where a local power plant plume is going to hit when it starts out.

But I don't see, in this part of the country, where general weather patterns are going to provide, with any specificity, where power plant plumes will go and impact.

Q. Dr. Tesche, I ask you to look at Plaintiff's Exhibit 193.

Dr. Tesche, this appears to be a replotting of one of your figures from your report by Messrs. Chinkin and Wheeler, moving from your type of scale to their alternate scale, which appears to be a nonlinear scale with different type of resolution. Do you see that, sir?

A. Yes, sir. I see this.

Q. I believe you have reviewed Dr. Chinkin and Wheeler's criticism of your scale and proposed using of what they term a finally resolved nonlinear scale in its place?

A. Yes. I saw that commentary.

Q. What is your assessment of their criticism?

A. Well, first off, they are correct that the plotting scheme that we -- that we employed to present our results did not make obvious, to the casual reader, some of the concentrations that are occurring out over the Gulf of Mexico or in Iowa, for example.

But let me be more to the point. Some of the

concentrations that are occurring in eastern portions of North Carolina, their choice of a nonlinear scale to provide more telescoping down into various concentration ranges, have given us a greater insight into our modeling numbers, as to where there is local variation in small concentrations in a much broader area.

And so I do not dispute the validity of their characterization of our results. I mean, these are the numbers that the EPA CMAQ model produced.

The question is, in my mind, is it -- you know, is it necessary to go to this level of detail, in small concentrations, in order to make the main salient point.

Or stated otherwise, are we at -- you know, are we at fault, or did we try to hide concentration impacts that are important in this proceeding?

And I maintain that, first, you know, the results were available to people that were -- that needed to see the numbers.

We've tried to present the main story, and where there was additional information that was necessary to present, we did so in the text of our report.

For example, where impacts in regions were colored over with the low end of the concentration range with gray, we tried to provide where those impacts were on the basis of supplementary examination of the data sets.

We, ourselves, performed telescoping -- not telescoping views, but we essentially winnowed our concentration fields to get a better picture of the variation in concentrations over different portions of the domain.

That's how I know, for example, that one of the grid cells that had a peak of .065 micrograms per cubic meter from TVA power plants was a third in North Carolina and two thirds in Tennessee.

We looked at those sorts of things, but we didn't believe in our presentation that going to this fine of detail in regions of North Carolina, but east Texas, was necessary.

MR. FINE: Ms. Shay, please display Plaintiff's Exhibit 164.

And again, Dr. Tesche, this appears to be a comparison between one of your figures and the figure being redone on a finally resolved nonlinear scale?

A. Can someone please help me out and read to me what the concentration increments are on the left side of this panel? I'm not able to make it out from this page. Or if I could have the original, I could probably read it.

Oh, wonderful. Thank you.

Q. What levels are we going down to in the finally resolved, nonlinear scale?

A. Can we move to the other panel, please? The one that's

finally resolved.

Great. Well, this is, indeed, a nonlinear scale. It goes from, let's say, in the bottom end minus .01. Seems to double approximately every color increment up to .2, at least. And I don't know what it is beyond that, probably .4, .5.

So the scale, indeed, is nonlinear. I think the nomenclature, "finally resolved" means that, because of the use of very small concentration levels, we're able to now get a picture of where in areas more distant from where the real atmosphere -- excuse me, where most of the higher impacts are, Tennessee and North Carolina, in this instance.

So, for example, we can see you know, how the concentration varies in central Georgia. We see how it varies across the State of North Carolina and in Ohio and so on and so forth.

The fundamental question, I think, that needs to be addressed is, does this manner of display of information provide additional useful information.

Q. Along those lines, Dr. Tesche, we're looking at this, levels of impact, sir. Do you know how this compares to how North Carolina has assessed the impact of certain pollutants or contributors to pollutants?

A. Not fully. I do have some information. I read their most recent PM 2.5 set that they were working hard and

VISTAS was working hard to develop the database sets for.

In that particular analysis I read was the appendix. And I don't recall the exact number. It may have been H or O or something like that. But it was the 2007 PM SIP produced by Sheila Holman at Division of Air Quality.

In that document, in that technical support document, they were commenting upon the concentration levels that were thought significant for their SIP plan.

And they declared that, for a particular species, which is a component of PM 2.5, but certainly not the overall PM 2.5 total, they set a level -- they established a level that, in their opinion, was a insignificant amount.

And they declared that if any of these -- if this particular species -- and it turned out to be ammonium nitrate was the species -- if the concentration of that species was less than .48 micrograms per cubic meter on an annual average, that it was the judgment of the State of North Carolina that it was insignificant.

Ammonium nitrate is a part of PM 2.5. It's not the biggest part. That role is reserved for sulfate, most often.

So if the State of North Carolina Division of Air Quality is going to assert that a concentration of a component of PM 2.5 at a level of .48 was insignificant, then, to me, that would say, why are we fooling around with

concentrations in the .01 range, or the .02 range, or the .03 range.

We can plot them up, but do they really contribute to the understanding of the problem? Is this a direct attack on trying to understand the chemistry and physics and reliability and uncertainty in models, or does this detract us from, really, the information at hand that the models are offering?

My judgment is that, sure, I can plot stuff like this, too. It doesn't add a whole lot of information other than the general geometry of the pollutant cloud carried farther away from where most of the impact is occurring.

That's my opinion on finally resolved, nonlinear-scale approach.

The authors don't provide in their technical report a whole lot of information that interpret this information.

Q. Which authors are you referring to?

A. I'm referring to Mr. Chinkin and Wheeler. Their technical reports don't interpret these scales and show what these contours mean.

Furthermore, they do not make the efforts to show which parts of this blue cloud are within the range of monitoring capability. We talked about that earlier as being .5 micrograms per cubic meter. Can't measure PM below that level.

North Carolina's DAQ says, even if it's a component of that below .048, it's insignificant.

So the authors don't show what is significant which is meaningful by North Carolina and which part isn't.

MR. FINE: Ms. Shay, please remove that document from the viewer.

One final area that I would like to go into with you briefly, Dr. Tesche.

I believe that you were present during Mr. Scott's testimony here yesterday?

A. Yes, sir.

Q. And I believe that you understand that there -- Mr. Scott's projections for TVA emissions in 2013 differ in some respects from Dr. Staudt's projections?

A. They are different, yes, sir.

Q. I would like to focus on just a couple of the differences, briefly, to obtain your views of their impacts on the modeling provided by Messrs. Chinkin and Wheeler in this case; in particular, some 28,000 tons of SO2 from TVA's Bull Run plant, and some at least 50,000 tons of SO2 from TVA's Kingston plant, to a total of something in the order of 80,000 tons from those two plants in east Tennessee.

Based on your experience in the modeling community and as a modeler, in your experience with atmospheric science, can you please tell us the source of impacts, on Mr. Chinkin

and Mr. Wheeler's modeling effort, their use of Dr. Staudt's figures for SO2 emissions for those plants have on their modeling for 2013?

A. My response would be in at least two categories.

First, the methodology that they perform is inconsistent with EPA guidance on how one carries out future year evaluations of alternative control strategies, in this case, alternative power plant emission reduction plants.

It's inconsistent because EPA's guidance on how you prepare emission inventories for these future year simulations, as I testified earlier, is very direct, very explicit, that you are to build your inventories for all source categories reflecting the best information about what the controls will be at the time that that modeling year comes around, notwithstanding the uncertainties that attend those estimates.

Mr. Chinkin and Mr. Wheeler did not follow that guidance, neither did Dr. Staudt. They used emission rates that were substantially higher, and in some cases, several orders of magnitude higher, than those projected by Mr. Scott and TVA as a result of controls that are sitting there on the ground right now, some that are in construction and some fuel switching that is planned.

So one response is, it is inconsistent with EPA guidance.

In Mr. Wheeler's testimony, he speaks of this use of the current year emissions, which is reflected in what Dr. Staudt proposed, as being the first step in the sort of modeling that air quality modelers do.

Mr. Chinkin and Mr. Wheeler did not take that second step, did not take that third step, specifically, on saying they did not project emissions to the future years that were expected to be in place in 2013 following EPA guidance.

So, in my opinion, they took the first step, which was to model emissions in all source categories around the United States, including North Carolina power plants, at the 2013 Clean Smokestacks levels. But then they modeled Tennessee Valley Authority sources at their present 2006 and 2007 models. I don't know what those results mean.

They certainly do not depict a scenario that is representative of some future set of alternatives.

And I don't know what information I can learn, or others could learn, from a control scenario comparison between future year conditions for all categories of sources in the region, but throwing in present controls on a facility that is undergoing major emissions reductions.

That's my second part of the response.

MR. FINE: That's all the questions I have, Your Honor.

THE COURT: All right.

MR. GOODSTEIN: Thank you, Your Honor.

CROSS-EXAMINATION BY MR. GOODSTEIN:

Q. Good afternoon, Dr. Tesche.

A. Good afternoon.

Q. One of your major assumptions of your modeling for 2013 was that TVA will implement its plan as projected; is that correct?

A. Yes, sir.

Q. And your modeling for 2013 compared TVA's plan to the Clean Smokestacks Act's equivalent levels determined by Dr. Staudt; is that correct?

A. That's correct, for the TVA plants.

Q. And your modeling that you presented in your report and here today for 2002, don't show any emissions reductions from the Clean Smokestacks Act on the North Carolina units, correct?

A. Sir, I don't know if I can say correct as an answer to that.

Q. You can agree with me any way you like, Dr. Tesche. You don't have --

A. Okay.

Q. -- you don't have to say correct.

A. Thank you. I'm still adjusting to this role.

The 2002 baseline inventory, that I played a role in developing for VISTAS, was constructed with every effort to

characterize emission levels that occurred throughout the eastern U.S., but especially in the States of Tennessee and North Carolina, as of 2002.

And to support that effort, especially for power plants, we looked at the acid rain databases from EPA to examine the continuous emission monitoring details that provide details of emission rates for SO2 and NOx and all those sources.

Furthermore, given the important role that North Carolina and DAQ played in the VISTAS process, they were involved in overviewing the assumptions going into the modeling for their state.

Since it was going to play a role in all the VISTAS modeling, 2002 baseline was important for the future year visibility projections. So they had a keen interest in making sure we got it right.

To be honest with you, I don't know firsthand if the Clean Air -- Clean Smokestack Act controls on the TVA -- excuse me, on the North Carolina power plants were put in place in the 2002 inventory.

But I can tell you that I would be surprised if North Carolina power plants were operating in 2002 at an emission level consistent with the Clean Smokestacks and that was not reflected in the 2002 base case.

Q. So that was a very long answer to a very basic

question, Dr. Tesche.

I'm just asking you the very basic question that, isn't it true that your modeling for 2002 doesn't include the emissions reductions on North Carolina located plants for Duke and Progress that are occurring now, and will be occurring in the next several years, under the Clean Smokestacks Act? That was modeling for 2002, wasn't it?

A. The modeling we did for 2002 was for 2002.

Q. Was for 2002?

A. Right.

Q. And the Clean Smokestacks Act was just passed in 2002, right?

A. Fine. Okay.

Q. So the emission reductions associated with that program were not yet implemented as of 2002, correct?

A. The objective of the 2002 simulation, per EPA guidance, is not to project into the future controls that are going to be put in line for 2002.

The objective, very clearly, per EPA guidance, is to assemble emissions as close to reality as occurred during that base year period.

Q. I think you're agreeing with me, aren't you?

A. I honestly don't know if I am or not. But what I am trying to tell you is that if there were controls on -- if there were Clean Air -- Clean Smokestacks controls imposed

on North Carolina sources in the year 2002, in that calendar year, if they were in place, then they would have been reflected in the inventory, or we didn't do our job thoroughly.

Q. Okay. But if they were required in 2007 or 2009 or 2013, those would not be included in year 2002 model?

A. That's exactly right.

Q. And if the emissions reductions occurred after 2002, and three, four, five years from 2002, that wouldn't be reflected in your 2002 modeling either, right?

If they started to build a scrubber in 2002 and it was not in place until 2004, 2005, 2006, that wouldn't be reflected in your 2002 model, correct?

A. Correct. Because that inventory is a base-year inventory for model verification. It's not a future-year inventory for strategy development. And EPA's guidance on how those inventories are developed are different.

Q. But it's not a 2007 inventory either?

A. No. Right.

Q. Its' not a current inventory, is it?

A. That's correct.

Q. It's a historical one?

A. Yes.

Q. So the historical comparisons that you presented to us in 2002 are just that, historical comparisons?

A. Yes.
Q. And just for clarification, you used the VISTAS version of CMAQ for your CMAQ modeling runs in this case; isn't that true?
A. Yes, sir.
Q. And so did STI; isn't that true?
A. We provided them with the VISTAS version. And they said they used a version 4.5, an older version of the model. I presume they used it.
Q. So as far as you know, they used VISTAS version of CMAQ as well?
A. The VISTAS version of the CMAQ photochemical model, yes.
Q. And you used the Base F Inventory for the year 2002 model, correct?
A. Correct.
Q. And Chinkin and Wheeler used the Base F Inventory for their CMAQ model, right?
A. Yes. We gave that inventory to them.
Q. You used the Base F Inventory for 2002 modeling because that was the most recent one that was available at the time you did that model, right?
A. Correct.
Q. And Chinkin and Wheeler used the Base F Inventory that was the most recent inventory available when they did their

model, right?
A. Yes, sir.
Q. And you found that the VISTAS Base F Emissions Inventory was acceptable for the purpose of regional modeling of ozone and fine particles and haze, correct?
A. I'm sorry, sir. Would you kindly repeat the first part of that question?
Q. Yes. You found the VISTAS Base F Emission Inventory to be acceptable for the purpose of regional modeling of ozone and fine particulate and regional haze. I believe that's what you testified to in your deposition.
A. At the time I made that statement, that was a true and correct statement on the basis of my knowledge at that time.
Q. Right. Now, you've also used inert tracers in approximately a dozen studies; isn't that true?
A. At least a dozen studies.
Q. One of the appropriate purposes of running tracer situations is to portray transport at ground and aloft; isn't that true?
A. If the model is properly exercised with the inert tracers, they can be helpful in revealing those dispersion patterns at the ground and aloft.
Q. In your practice, you've also used nonlinear scales, correct?
A. At times, yes.

Q. And the major difference about the way you set up the 2013 CMAQ modeling and the way STI set it up is the estimated 2013 emissions for TVA, correct?

A. No, sir. We made a number of model simulations, both of the base year and 2013.

We used a common -- at least we used the same model consistently, but we used different base cases. And so there was a step-up in the modeling work we did to make a more correct emission inventory when we modeled 2013, the VISTAS Base G.

Q. Okay. Can we put up page 128 and -- 128, 124 through 129 and 126 of Dr. Tesche's deposition.

Do you recall giving a deposition in this case, Dr. Tesche?

A. Yes, sir I do.

Q. On November 15th?

A. Yes.

Q. 2007. And do you recall me asking you the following question:

"So the big difference about the input to the model and the way it was set up and run for the 2013 simulation was the base case, correct? That's the big difference between your model results and the STI model results, is the TVA emissions?"

"Answer: For 2012.

"Question: Yes.

"Answer: Correct. As inputs to the simulation."

Do you recall giving that testimony, Dr. Tesche?

A. Yes, I recall it.

Q. All right. Now you were a co-principle investigator on the VISTAS program; is that correct?

A. Yes, sir.

Q. And you used the CMAQ -- VISTAS version of CMAQ in that study to evaluate regional air quality, correct?

A. We used several versions of the CMAQ model to evaluate air quality.

Q. So, in this study, you had other employees at Alpine Geophysics deal with emissions inventory for this particular case; is that correct?

A. That's correct, yes.

Q. You actually work in a virtual firm, don't you, Dr. Tesche?

A. Well, I would suggest that our revenues and our clientele would put us into more of an actual firm than a virtual firm. We do real work.

Q. What I mean to suggest is that you are not all located in an office somewhere; is that true?

A. No, we are not. With the exception of two partners, we maintain our separate work spaces. Since we're connected electronically, it's like working for Bechtel, where you're

on different floors of the same building. We see each other regularly at conferences and professional meetings and project meetings.

Q. You work in your basement in Kentucky; is that correct?

A. Yes. I have an office in the lower floor of my home. Yes, it is a basement.

Q. And Ms. Loomis, who assembled the emissions inventory files for Alpine Geophysics, works in her home in Colorado; isn't that true?

A. In her basement, yes.

Q. And her husband, Mr. McNally, ran the CMAQ runs for this particular project; isn't that true?

A. For the TVA simulations and for a number of VISTAS simulations, yes, Dennis did the CMAQ and the CAMx simulations.

Q. And Ms. Loomis received the estimates of TVA's 2013 emissions from Mr. Scott for TVA, correct?

A. Correct.

Q. And you didn't review those emission files yourself?

A. I did not review the electronic files that were produced from the tabular summaries given Cindy Loomis by Mr. Scott. Nor did I review the tabular files that she -- or excuse me. I didn't review the electronic files that she generated from the tabular listing of Dr. Staudt's emissions in the Chinkin and Wheeler report.

Q. And you didn't speak to Mr. Scott, who prepared the estimates for TVA before you generated your report?
A. No, sir, I did not.
Q. You didn't review TVA's Clean Air Plan on which the 2013 emissions are based?
A. Prior -- up to what?
Q. At the time you finalized your report here and formulated your conclusions here.
A. Yes, sir. I -- that's correct, I did not.
Q. And you didn't consider whether the emissions reductions that TVA was projecting, were legally required or not, correct?
A. I did not go into the regulations of the State of -- or federal agency to look and see whether the TVA plan was consistent with those regulations. I did not, obviously, look at the permit.
Q. So, as you said in your deposition and said here today, you are not prepared to testify to the accuracy and the methods used by TVA to come up with their 2013 emission estimates, right?
You made that very clear in your deposition, that you weren't going to be testifying to that.
A. That is correct. I cannot comment on the accuracy of the tons per day or of NOx and SO2 that were estimated by the TVA.

Q. All right. And it's your opinion that SO2 emissions are fairly proportional to PM 2.5 levels in the southeast; isn't that true? I think you said that earlier today and you also said that in your deposition?

A. What I know to be the case, what my technical understanding is, is that there is a fair degree of linearity between SO2 emissions and downwind SO4, or sulfate, concentrations. There's a pseudo-linearity there, such that sulfate scales proportionally with SO2 emissions.

In the southeastern United States, sulfate is the predominant component of PM 2.5. So that being said, there is some correlation between SO2 and PM 2.5.

Q. If you reduce SO2 in the southeast, you will reduce PM 2.5 fairly proportionately, right?

A. If the PM 2.5 concentrations are predominantly comprised of sulfate, that is correct.

Q. So if you reduce SO2 emissions from TVA's EGU's, it will reduce PM 2.5 in the areas overlaying by those plumes, correct?

A. Yes. I think that's a fair statement.

Q. And it's possible for a given comparison between monitored and modeled values, that in some instances the modeled value is actually more representative of actual concentrations in that grid than the monitored value; isn't that true?

A. That's true, especially in situations where the monitor may be influenced by measurement uncertainty or by local effects.

MR. GOODSTEIN: Can we put up Defendant's Exhibit 310, please.

Dr. Tesche, you testified earlier about this error in your emissions inventory. And this is the one where two of the three units were omitted at the Allen plant; is that right?

A. Yes. I remember this table.

Q. Okay. And so this error that was made in your emissions inventories that went into your modeling, this is showing that the error was a 65 percent error, underestimating the emissions from the Allen plant; is that right?

A. For sulfur dioxide, correct.

Q. And the Allen plant is impacting air quality in Tennessee and Kentucky; isn't it?

Well, let me rephrase that.

The Allen plant is located close to Memphis, Tennessee, isn't it?

And you can refer to Defendant's Exhibit 1 before you.

A. I can see it from here. Yes, sir.

Q. Okay. So that the Allen emissions of SO2 would be influencing air quality in Memphis, Tennessee, correct?

A. The Allen emissions would be influencing air quality in Memphis?
Q. Yes.
A. What kind of air quality are you referring to?
Q. PM 2.5, talking about SO2.
A. I think that's a reasonable supposition. There are a number of components of PM 2.5, including primary particulate, and given the close proximity of those two sources, it wouldn't surprise me to see that a greater fraction of the PM 2.5 modeled impact, that close to the Allen facility, would be more primary particulate than secondary.
Q. And the NOx from the Allen plant would be influencing ozone levels in the Memphis area; is that true?
A. It could, if the plume mixed down to the ground. From this map, I can't tell the number of kilometers that the two are separated.

But, you know, if the plume is mixed to the ground, in convectively active daytime periods, the concentrations could affect Memphis.

In other days -- in nighttime for example, wind shear, for example, they could blow to east Texas.
Q. Are you aware whether Memphis is out of attainment for either ozone or PM 2.5?
A. Sir, that's not a fact that I have in my head right

now. I don't know.

Q. That's not something you considered in your analysis, the impact of the nonattainment areas in Tennessee?

A. In Tennessee? That wasn't a primary focus of our analysis. Although, we did present results that, for both PM and ozone, showed the projected future year concentrations of those species throughout both states and the whole eastern United States.

Q. But your primary focus wasn't on the impacts of air quality -- the impacts on air quality of emissions from TVA facilities in Tennessee, Alabama, Kentucky, correct? That wasn't a primary focus?

A. I'm sorry, please --

Q. You were primarily looking at impacts on North Carolina?

A. No, sir. That's not correct.

Q. But you didn't look at -- so what you're saying is you didn't look at the impacts on the nonattainment areas in Kentucky, Tennessee and Alabama?

A. That wasn't our primary focus. What we were trying to understand is the geographical extent of impacts from the various categories of power plants in both states, as well as anthropogenic sources.

And we tried to get some context for where those impacts were with the emphasis on the two states, but

clearly toward North Carolina.

Q. Right. Thank you.

Let's look at -- can we put up Defendant's Exhibit 210, please -- 274. Let's put up Defendant's Exhibit 274.

This is a copy of your report, Dr. Tesche?

A. This is our supplemental report issued June of 2007.

Q. All right. And your opening report is 273; is that right?

A. I believe they come in that order.

Q. Okay. So can we turn to page 84 of your opening report, Dr. Tesche, please.

And we're going to put this page up on the screen so everyone can see it.

Isn't it true that the ozone fractions are reported to the second decimal place on your figure 4-30?

A. Yes.

Q. Let's go to page 98 of the same document.

Isn't it true this data is reported to two decimal places?

A. Can we go back to that?

Q. Page 98?

A. Can it be expanded? I'm not able to see it clearly.

Q. So three more pages up.

Table 4-6 on page 98 of your report. Do you have it in front of you, Dr. Tesche?

A. Oh, I'm sorry. Yeah. I've got it here. Excuse me. Yes, sir. I have it here.
Q. So this data is reported to the second decimal place; is that correct?
A. Well, this is visibility data. You are correct that there are two decimal places in the numbers in this table.
Q. Okay. And let's go to page 130 of your report, figure 5-11. That's reported to two decimal places, isn't it?
A. The plotting scale that we're using here goes or has two decimal places, yes. Goes from zero to .50.
Q. Thank you. And on page 162 of your report, that plotting scale is also to two decimal places, isn't it?
A. Yes, sir.
Q. And then your supplemental report, which is the next exhibit, 274, this is Table 2, page 7 of 274, some of that data is reported to two decimal places as well, correct?
A. Yes, some of it is.
Q. And I believe you testified earlier that EPA, in its CAIR modeling, reports results to two decimal places, isn't that true?
A. Yes.
Q. Let's look at Defendant's Exhibit 276. And it's true that this figure cuts off any results below two parts per billion, correct?
A. No, it doesn't cut them off.

Q. Well, you can't tell what is going on below two parts per billion?
A. Well, that's true in some respects. But you can see the geometry of the bandwidth from zero to two.
Q. But you can't tell what's going on between one part per billion and two parts per billion, can you?
A. No, sir. In the same way you can't tell what's going on between 10 and 12. It's all within that range.
Q. And this particular figure shows impacts, for example, from the Widows Creek plant in Chattanooga?
A. Can you direct me to the page, please?
Q. Same figure.
A. Same page.
Q. Defendant's trial Exhibit 276.
A. Okay. And what was the question, again? I'm sorry.
Q. This shows impacts from the Widows Creek plant on Chattanooga, Tennessee; isn't it true?
A. Well, Chattanooga is not listed as a landmark on this plot. But to the extent that it's close to the Widows Creek facility, then this iso plot, this residual plot, would provide an impact of what those impacts would be.
Q. I would like to refer your attention now to Defendant's Exhibit 304, Dr. Tesche.
Isn't it true that this figure contains all the motor vehicle emissions in North Carolina?

A. Yes, sir.
Q. Let's look at Defendant's Exhibit 292 which you testified to in your direct.
This doesn't show any distribution below four parts per billion, correct? Defendant's Exhibit 292.
A. Please?
Q. It doesn't show the distribution below four parts per billion, correct?
A. From this plot, the reader is not able to discriminate between a value of four or zero or anywhere in between. And one could not --
Q. I'm sorry.
A. As one could not discriminate between values between four to nine.
Q. And it doesn't show the maximum value either, does it?
A. The -- it doesn't show the maximum value?
Q. Correct. The maximum value is 43. It doesn't show it on the scale. Scale only goes up to 36, correct?
A. Yes, that's correct.
If the reader was interested in knowing where that was located, they could use the coordinates given here, 62, 107, X equals 62, Y equals 107. And with a ruler, you could -- you would find that it occurs probably in the center of the red dot there.
We haven't used a scale at the higher end of the

concentration range to provide a focus on that, on the changes in concentration in the vicinity of that particular peak impact. This plot isn't designed to show that.

MR. GOODSTEIN: If I could have a moment, Your Honor?

(Pause.)

MR. GOODSTEIN: I have no further questions of Dr. Tesche, Your Honor.

MR. FINE: No further questions, Your Honor.

THE COURT: All right. The witness is now excused. Your testimony has been completed.

THE WITNESS: Thank you.

THE COURT: All right. Recess until tomorrow morning at 9:00 a.m.

(End of Proceedings.)

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UNITED STATES DISTRICT COURT

WESTERN DISTRICT OF NORTH CAROLINA

CERTIFICATE OF REPORTER

I, Laura Andersen, Official Court Reporter, certify that the foregoing transcript is a true and correct transcript of the proceedings taken and transcribed by me.

Dated this the 28 day of July, 2008.

s/Laura Andersen
Laura Andersen, RMR
Official Court Reporter